Welsh Birds

THE NATURAL
HISTORY MUSEUM
13 JUL 2005
PRESENTED
TRING LIBRARY

Vol 4 No.3 2005

CYMDEITHAS ADARYDDOL CYMRU
WELSH ORNITHOLOGICAL SOCIETY

WELSH ORNITHOLOGICAL SOCIETY

CYMDEITHAS ADARYDDOL CYMRU

Officers and Members of Council as at April 1st 2005.

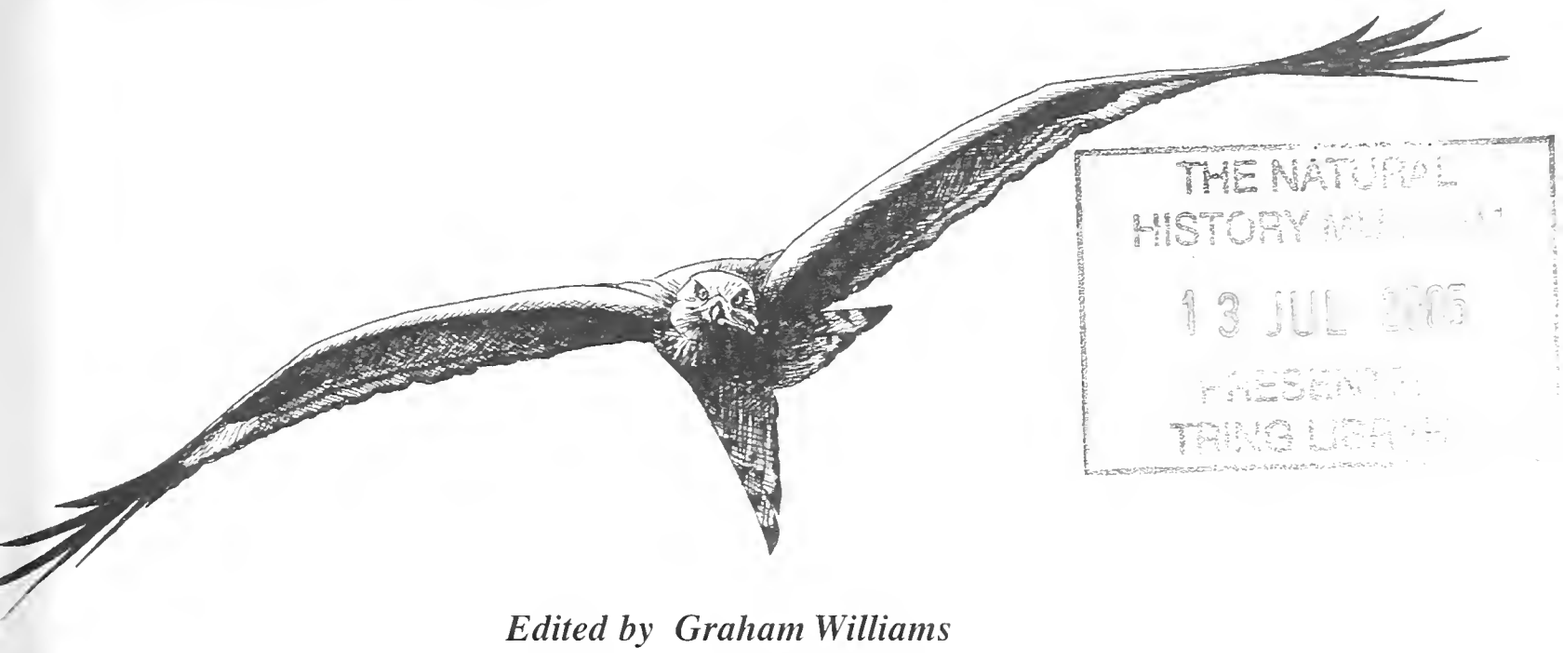
President:	David Saunders
Chairman:	Dr. Tony Prater 60 Hastings Crescent, St. Mellons, Cardiff CF3 9ET
Vice-Chairman:	To be appointed
Hon. Secretary:	Paul Kenyon 196 Chester Road, Hartford, Northwich, Cheshire CW8 1LG
Membership Secretary and Hon. Treasurer:	Alan Williams 30 Fairfield, Penperlleni, Pontypool, Gwent NP4 0AQ e-mail: alan.williams6@virgin.net
Editor, Welsh Birds:	Graham Williams 14 Dolerw Park Drive, Newtown, Powys SY16 2BA e-mail: grahamwilliams@mid-wales.net
Editor, Welsh Bird Report:	Jon Green Crud yr Awel, Bowls Road, Blaenporth, Cardigan SA43 2AR e-mail: jrgreen@onetel.com

Council Members:

John Barnes
Norman Hallas
David Hewett
Brayton Holt
Peter Howlett
Peter Jennings
Andrew King
Chris Jones
John Lloyd
Steve Moon
Carlton Parry
Rhion Pritchard
Rob Taylor
Reg Thorpe

WELSH BIRDS

Vol. 4 No. 3 **2005** **ISSN 1359-1649**



THE NATURAL
HISTORY
13 JUL
TRING

Edited by Graham Williams

CONTENTS:

Editorial and Acknowledgements 181

Breeding Seabirds in Wales 183

Densities of breeding Skylarks *Alauda arvensis* in upland Wales 219

Peregrine *Falco peregrinus* predation of Woodcocks *Scolopax rusticola*: Evidence of nocturnal hunting 221

A study of breeding Carrion Crows *Corvus corone* in Snowdonia 227

Measuring the diet of Choughs *Pyrrhocorax pyrrhocorax* in north Wales 236

Autumn sea-watching at Strumble Head, 1994-2003 247

Short Notes 268

Cover photograph by Dave Brassey

Text illustrations by Bob Mitchell, Colin Richards and Steve Roberts

Published in June 2005 by the Welsh Ornithological Society

(Charity Number 1037823)

www.welshornithologicalsociety.org.uk

Price - £5.00

EDITORIAL

I am encouraged by the positive reaction to the new style of cover introduced last year, so I am continuing in this vein, featuring the splendid photograph of the 2004 Golden Oriole at Abergavenny by Dave Brassey. My thanks to him and to Jonathan Williams of Severn Media Group who is responsible for the excellent design.

A conscious decision was also reached this year to produce an enlarged journal, a reflection of the number and variety of papers submitted for consideration, in itself a recognition of the commendably wide span of ornithological research and survey which is being undertaken in Wales.

It is a pleasure to be able to publish the comprehensive review of breeding seabirds in Wales by Dr. Ian Mitchell, a paper of very considerable importance which includes not only the results of the major survey of Seabird 2000 but also subsequent published and unpublished data. It measures the importance of our breeding seabirds in an international context and provides a benchmark against which any future surveys will be measured.

Still on seabirds, Jon Green pays fulsome tribute to the dedicated enthusiasts who log the autumn passage off Strumble Head, using the impressive expertise he has garnered in recent WOS publications to number crunch the huge amount of data gathered there and present it in informative fashion.

The Carrion Crow is a widespread and common species throughout much of Wales but has not received the attention it deserves as a significant and influential member of our avifauna. This is now corrected by Julian Driver's intensive and painstaking research of the breeding population of the northern slopes of the Carneddau which elucidates the breeding biology of this interesting species.

By contrast, the Chough has frequently featured in previous editions of "Welsh Birds".The paper by Dr. Sian Whitehead and Dr. Ian Johnstone is very valuable in adding to our knowledge of the diet of Choughs in north Wales whilst identifying the potential for further work on the measurement of prey abundance.

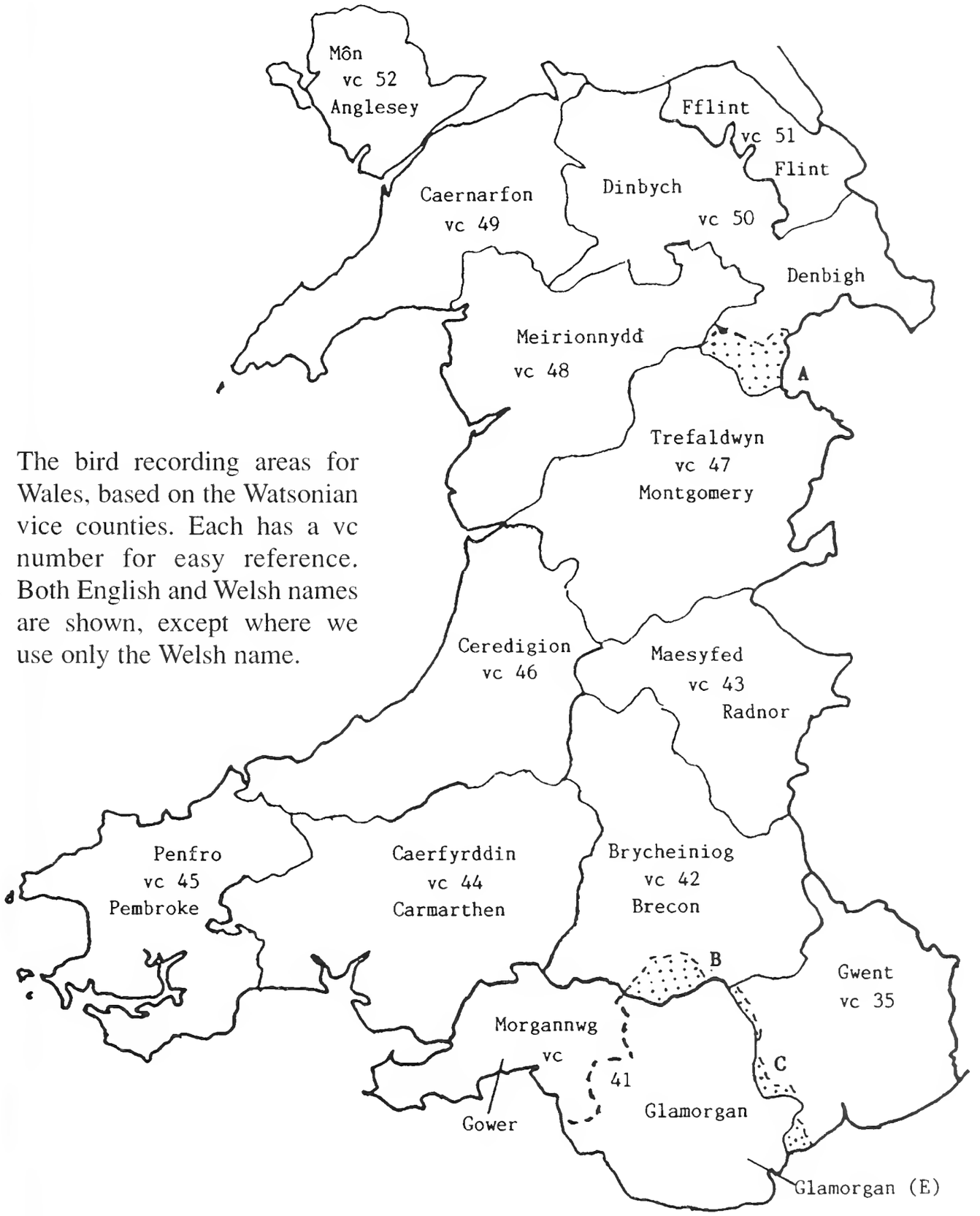
Likewise. Peregrines have often featured in these pages, often through the investigative fieldwork of the South Wales Peregrine Monitoring Group. An interesting facet of Peregrine diet is explored in the paper by Andrew Dixon and Colin Richards, indicating that Peregrines can probably hunt successfully after sunset.

It has long been recognised that the Welsh uplands are important for breeding Skylark but the result of surveys by Mick Green of four well scattered areas suggests that the population is of even more significance than previously realised. These fascinating data were gleaned, interestingly, as a by-product of other work. Further work on this subject would be of great interest in view of the Skylark's amber-listed status.

ACKNOWLEDGEMENTS

My very grateful thanks to the illustrators, Bob Mitchell, Colin Richards and Steve Roberts, to the photographer, Dave Brassey and to the referees for their constructive comments (Michael Shrubb for Carrrion Crow, Chough and Skylark papers, Dr. Graham Hirons for the Peregrine and Woodcock paper, Hywel Roderick for the breeding seabird paper and Dr. Peter Dare for the Strumble Head paper). Last, but by no means least, thanks to all the authors for making their work available and for writing it up for this journal

The Bird Recording Areas in Wales



The bird recording areas for Wales, based on the Watsonian vice counties. Each has a vc number for easy reference. Both English and Welsh names are shown, except where we use only the Welsh name.

BREEDING SEABIRDS IN WALES

— *P. IAN MITCHELL* —

Joint Nature Conservation Committee, Dunnett House,
7 Thistle Place, Aberdeen AB10 1UZ

INTRODUCTION

This paper reports on the results of Seabird 2000 in Wales, to assess the current status of breeding seabird populations. Seabird 2000 is a census of all 25 seabird species that regularly breed in Britain and Ireland, conducted during 1998-2002 (Mitchell *et al.* 2004). The project was co-ordinated by the Joint Nature Conservation Committee, the UK government's advisor on nature conservation, in partnership with the country nature conservation agencies including the Countryside Council for Wales, and non-governmental organisations such as the Royal Society for the Protection of Birds.

Seabird 2000 followed on from two previous censuses: Operation Seafarer in 1969-70 (Cramp *et al.* 1974) and the Seabird Colony Register (SCR) Census in 1985-88 (Lloyd *et al.* 1991). This paper compares results from all three censuses to determine trends in seabird numbers in Wales over the last 15-30 years. The project also provides an accurate baseline on which to compare future monitoring. For the first time, Seabird 2000 conducted a comprehensive survey of nocturnal species throughout Britain and Ireland, including internationally important colonies in Wales. Furthermore, Seabird 2000 also surveyed inland colonies of terns, gulls and Cormorants (*Phalacrocorax carbo*), in contrast to Operation Seafarer and the SCR Census, which confined surveys to the coast.

The results of Seabird 2000 are a major contribution to the implementation of the Birds Directive (EC Council Directive on the Conservation of Wild Birds – 79/409/EEC),

which covers the protection, management and control of all naturally occurring birds, their eggs, nests and habitats within all EU Member States. Of the 20 species of seabird currently breeding in Wales, six are listed in Annex I of the Directive (i.e. Storm Petrel and all five tern species) and therefore warrant special conservation measures concerning their habitat. Furthermore, Article 4 of the Directive has led to the creation of a network of Special Protection Areas (SPA) throughout the European Union that contain important habitat for breeding, wintering and migrating birds listed in Annex I and a further 13 regularly occurring migratory species of seabird in Wales, not listed in Annex 1. In Wales, 18 such sites have been included in the SPA Network, of which six are listed because of seabird interest. The Birds Directive states that habitat within SPAs should be protected from deterioration to ensure the survival and reproduction of important endemic bird populations. A crucial part of SPA management is the regular monitoring of trends and variations in population levels.

METHODS

The survey methods implemented during Seabird 2000 were identical to those outlined in the *Seabird Monitoring Handbook* (Walsh *et al.* 1995) and to those of Gilbert *et al.* (1998) for Storm Petrel (*Hydrobates pelagicus*). The implementation of these methods during Seabird 2000 is detailed in Mitchell *et al.* (2004). Appendix I summarises the prescribed seasonal and diurnal timings and units for counting each species. For most species, apparently occupied nests/sites/territories were counted and taken to equate to the number of breeding pairs. The exceptions were Razorbills (*Alca torda*), Guillemots (*Uria aalge*) and Black Guillemots (*Cepphus grylle*), which were counted as individual birds. Guillemots do not build a nest, but lay a single egg on bare rock amongst dense aggregations of both breeding and non-breeding birds on cliff ledges, on top of stacks and under boulders. It is very difficult, if not impossible, to distinguish breeders from non-breeders, so all birds attending breeding ledges are counted during the first three weeks of June when day to day variation in numbers is less than at other times during the breeding season (see Walsh *et al.* 1995). Likewise, Razorbills do not build nests, laying their single egg on ledges or in rock crevices and under boulders, but do not tend to collect in as large aggregations as Guillemots; nest sites tend to be hidden from view and thus all birds attending the colony are counted as with Guillemots. Black Guillemots lay their two eggs in rock crevices hidden from view and tend not to be associated with the large cliff-nesting seabird colonies and thus small, scattered colonies are difficult to find during the nesting season. Therefore, Black Guillemots are surveyed by counting the number of pre-breeding adults aggregating on land or on the sea adjacent to colonies at first light during courtship in April when they are much more conspicuous than later on during the breeding season.

The recommended count unit for Puffins (*Fratercula arctica*) during Seabird 2000 was the apparently occupied burrow (AOB), which were not accessible to surveyors at some colonies and in such circumstances the number of individuals attending the colony were counted. During the SCR Census and Seabird 2000, respectively 95% and 89% of the population in Wales was surveyed by counting individuals, and then converting these counts into estimates of breeding pairs. On the Pembrokeshire islands of Skomer and Skokholm during both the SCR Census and Seabird 2000, repeated counts of birds attending the colony early in the season (when only breeding adults will have been

present) were divided by 1.5 to estimate the number of pairs, assuming that 75% of all breeding adults were present. Elsewhere, counts of individuals were taken as equal to the number of pairs present (Harris 2004).

A major achievement of Seabird 2000 was to improve our knowledge of abundance and distribution of nocturnal species (i.e. Storm Petrels (*Hydrobates pelagicus*) and Manx Shearwaters (*Puffinus puffinus*)) through the use of the recently developed tape-playback technique. Storm Petrels and Manx Shearwaters nest underground and hidden from view in burrows or in rock cavities and only appear above ground at colonies during the hours of darkness. Tape-playback (see Ratcliffe *et al.* 1998a) involves playing tape-recordings of the calls of Storm Petrels or Manx Shearwaters during the day in suitable nesting habitat in order to elicit calls from adults while incubating in nest cavities and burrows. At some Manx Shearwater colonies (e.g. Bardsey Island) their burrows were visibly conspicuous and were counted directly, although tape-playback proved invaluable at other colonies (e.g. Skomer) in distinguishing Shearwater burrows from those of Puffins and Rabbits (*Oryctolagus cunniculus*).

Coverage of coastal seabird colonies in Wales was complete except for four small colonies of Fulmars and gulls: at Friog Cliffs (Meirionnydd), Denby Island (Gwent), Telpyn Point and Gilman Point (both Carmarthen). Colonies of inland gulls were targeted using a combination of sources, including previous records held on the SCR database and by local County Bird Recorders. Any sites that were previously unreported were either missed or reported on an ad hoc basis by surveyors that knew of their existence. Inland colonies were defined as those situated more than 5km from the mean high-water mark (OS Boundary-Line ™© Crown Copyright). An aerial survey of roof-nesting gulls in south Wales (from Swansea to Cardiff including as far inland as Merthyr Tydfil) was conducted in 2002. All Cormorant colonies were surveyed in Wales (except a colony on Denby Island, Gwent formed in 1999), aided by contributions from the ongoing Cormorant Breeding Colony Survey co-ordinated by Robin Sellers.

For each species, counts from Seabird 2000 and the SCR Census (1985-88) have been summarised by Watsonian Vice-counties. These Vice-county totals have been compared to those from Operation Seafarer (1969-70) given in Cramp *et al.* (1974). The resultant total for Wales for Operation Seafarer is slightly different from that given in Lloyd *et al.* (1991) (and reproduced in Mitchell *et al.* (2004)) who reanalysed the raw data from Operation Seafarer but summarised it by Welsh Counties (1974-96) rather than Watsonian Vice-counties. However, Cramp *et al.* (1974) did not give Vice-county totals of Fulmars and Puffins and expressed counts of Razorbills and Guillemots as pairs and therefore are incomparable with counts of individuals from SCR Census and Seabird 2000. For these four species, population estimates for Wales during Operation Seafarer (1969-70) were taken from Lloyd *et al.* (1991).

RESULTS

Over 600,000 seabirds of 20 species were recorded breeding in Wales during Seabird 2000 (1998-2002), around 10% of the breeding seabird population in Britain, Isle of Man and the Channel Islands. Wales holds over 10% of the British population of six species and more than 1% of the biogeographic population of eight species (Table 1).

Table 1. Total numbers of seabirds breeding in Wales 1998-2002. Figures refer to pairs unless stated otherwise.

Species	*Wales*	*Great Britain, Isle of Man and Channel Islands*	*Percentage of GB population in Wales*	*Percentage of Biogeographic population[1] in Wales*
Fulmar	3,474	499,081	0.7	0.1
Manx Shearwater	168,133	295,089	57.0	41.0-49.5
Storm Petrel	2,703	25,710	10.5	0.4-0.9
Gannet	30,688	226,553	13.5	7.9
Cormorant	1,699	8,470	20.1	3.2-3.3
Shag	914	28,579	3.2	1.3-1.4
Black-headed Gull	1,986	127,907	1.6	0.1
Lesser Black-backed Gull	20,722	111,835	18.5	11.6
Herring Gull	13,974	142,942	9.8	1.7-2.0
Great Black-backed Gull	427	17,394	2.5	0.4
Kittiwake	7,293	366,835	2.0	0.2-0.3
Sandwich Tern	450	10,536	4.3	0.6-0.7
Roseate Tern	2	52	3.8	<0.1
Common Tern	674	10,308	6.5	0.2-0.3
Arctic Tern	1,705	52,621	3.2	0.1-0.3
Little Tern	75	1,947	3.9	0.3-0.4
Guillemot[2]	57,961	1,322,830	4.4	1.3-1.4
Razorbill[2]	12,638	164,557	7.7	1.6
Black Guillemot[3]	28	38,142	<0.1	<0.1
Puffin	10,328	579,500	1.8	0.2

[1] Biogeographic population defined for each species in Stroud *et al.* (1991). Biogeographic population sizes taken from Mitchell *et al.* (2004)
[2] counts of individuals
[3] counts of pre-breeding adults

N.B. For terns and Gannets the figures presented are from the period 1998-2002 (i.e. 2000 for terns and 1999 for Gannets) but there have been subsequent surveys of all Welsh colonies that are detailed in the separate species' accounts.

Excluding Storm Petrel and Manx Shearwater, which were not surveyed during Operation Seafarer (1969-70) and the SCR Census (1985-88), the total number of seabirds breeding along the coast of Wales has increased from 213,000 in 1969-70 and 218,000 in 1985-88 to 257,000 in 1998-2002. However, trends varied greatly between different species and the results for each species are described in turn below.

Fulmar *Fulmarus glacialis*

Despite being Britain's third most common breeding seabird, less than 1% of the British population breeds in Wales (Table 1). However, the population in Wales has continued to increase in size since 1969-70, whereas numbers in denser parts of the species' range along the North Sea coast and in Shetland have declined since the SCR Census (1985-88) and the population of Britain as a whole has . remained stable since 1985-88 (Table 2). Fulmars in Wales are confined to sea-cliffs (Figure 1), apart from in Flintshire and Denbighshire where they nest in quarries and on inland crags (Dulas Valley) due to a dearth of natural coastal cliffs; the distribution shows that they occupy much of the coast spreading south east to Nash Point, Glamorgan. While numbers in Wales have increased since 1985-88, there is a north-south divide with numbers between Flintshire and north Ceredigion having decreased and numbers to the south having increased. On Skomer, the largest colony in Wales has increased in size from 472 AOS in 1985 to 691 AOS in 2000.

Table 2. Numbers of breeding Fulmars (AOS) in Wales 1969-2002.

Watsonian Vice-county	*Operation Seafarer (1969-70)*[1]	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*
Flintshire	-	6	3	-	-50	-5.0
Denbighshire	-	61	43	-	-30	-2.0
Caernarfon	-	488	207	-	-58	-6.0
Anglesey	-	389	302	-	-22	-2.0
Meirionnydd	-	25	0[a]	-	-100	-100.0
Ceredigion	-	350	396	-	13	1.0
Pembroke	-	1,401	2,474	-	77	4.0
Carmarthen	-	16	0[b]	-	-100	-100.0
Glamorgan	-	5	49	-	880	17.0
Wales total	925[2]	2,741	3,474	276	27	1.7
Great Britain, Isle of Man & Channel Islands total	289,641	516,062	499,081	72	-3	-0.2

[1] Cramp *et al.* (1974) do not summarise Operation Seafarer counts of Fulmars by Watsonian vice-counties
[2] Population estimate for Wales during Operation Seafarer from Lloyd *et al.* (1991)
[a] The colony at Friog Cliffs, Meirionnydd (25 AOS in 1986) was not surveyed during Seabird 2000.
[b]Colonies in Carmarthen at Telpyn Point and Gilman Point (10 AOS and 6 AOS respectively in 1987) were not surveyed during Seabird 2000.

Manx Shearwater
Puffinus puffinus

Wales holds 41-49% of the world population of Manx Shearwaters, distributed on four Pembrokeshire islands: Skomer (101,800 AOS, 95% CLs 98,824 – 104,768), Skokholm (46,200 AOS), Middleholm (3,000 AOS), Ramsey (950 AOS, min/max 900 – 1,000), and on Bardsey/Ynys Enlli, Caernarfon (16,183 AOS). Experiments to establish a colony on Cardigan Island in the early 1980s appear to have been unsuccessful. Birds have been recorded calling over land at Carmel Head, Anglesey during 1972-82 (Lloyd *et al.* 1991), and attempted to breed in 1966 at an undisclosed site on Anglesey and were heard calling at the same site in 1967 and 1974 (Jones &

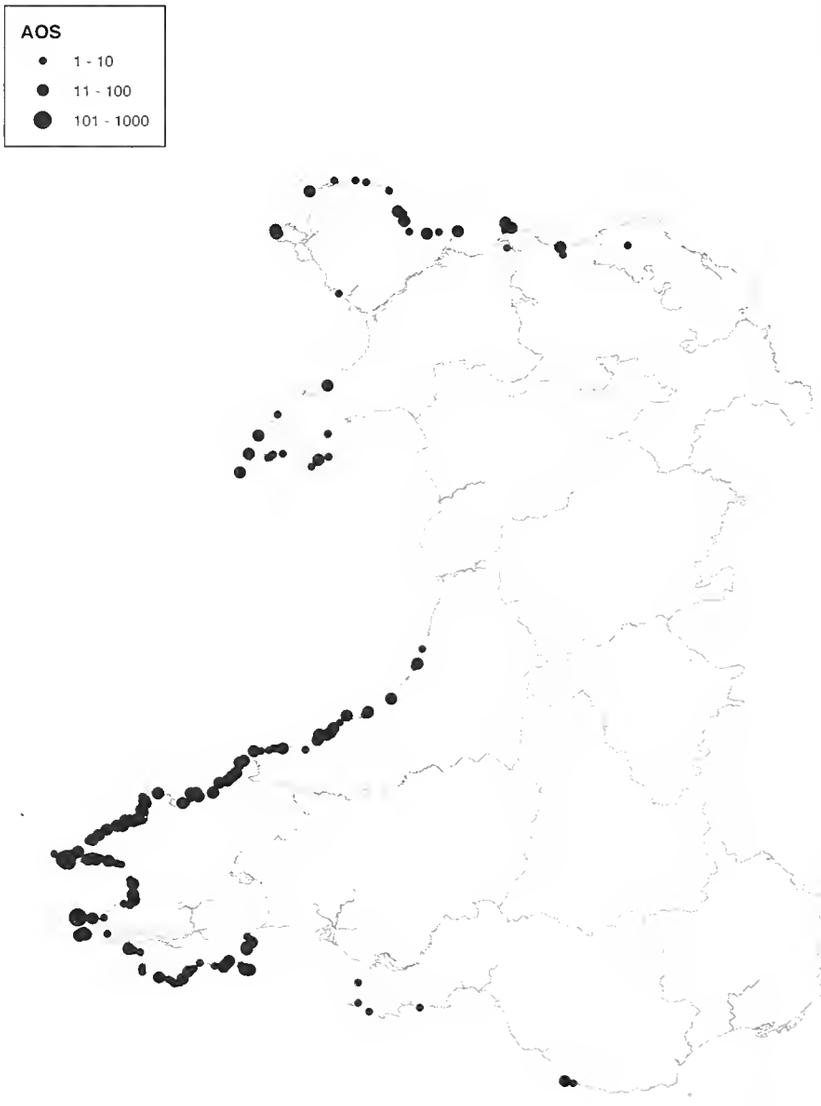


Figure 1. Abundance and distribution of breeding Fulmars in Wales 1998-2002

Whalley 2004); but there is no definite proof of breeding on the island and no survey was conducted during Seabird 2000, so breeding presence has yet to be confirmed. Cadman (1936) apparently found Manx Shearwaters nesting on the Pembrokeshire mainland and for many years, birds were heard calling on cliffs just north of Aberystwyth (H. Roderick pers. comm.), but current breeding seems unlikely given the presence of ground predators along the mainland coast.

The 'super-colony' on Skomer, Skokholm and Middleholm held 151,000 AOS in 1997-98 (Smith *et al.* 2001) and is the largest in the world. It is difficult to assess whether this population is increasing or decreasing, since no complete census had ever been conducted previously on any of the three islands. However, on Skokholm, Smith *et al.* (2001) suggest that there may have been a 30% increase over the last 30 years based on estimates using mark-recapture of fledglings conducted in the mid-1960s. There have been several attempts to estimate the size of the population on Skomer over the last 30 years, incorporating a variety of methods (see Smith *et al.* 2001 for a review). For instance, Brooke (1990) estimated the total population at 100,000 pairs from sample counts of fledglings. The only previous play-back survey conducted on Skomer was in 1995 (Gibbons & Vaughan 1998), but this was confined to the area of the island called 'The Neck', which held 26,500 AOS (95% CLs 21,000-32,000) in 1995 compared to 18,807 AOS during the complete census in 1997-98. Smith *et al.* (2001) argue that the 1995 survey may have over estimated the number of AOS present and been biased towards dense areas because of the small proportion of total area (i.e. 1%) that was sampled.

Storm Petrel *Hydrobates pelagicus*

Wales holds 11% of the British population of Storm Petrels, distributed on four Pembrokeshire islands: Skokholm (2,450 AOS, 95% CLs 2,300 – 2,600), Skomer (110 AOS), Ramsey Island RSPB Reserve (108 AOS) and on Bardsey/Ynys Enlli, Caernarfon (35 AOS). Two identical surveys of Storm Petrels carried out on Skomer in 2001 and 2003 (after completion of the Seabird 2000 survey) found more occupied sites and suggested the population on the island may be nearer 200 pairs (J. Brown, unpubl.). Cramp *et al.* (1974) recorded 1-9 pairs on Middleholm in 1969-70 and they were recorded breeding there in 1985-88 (Lloyd *et al.* 1991).

On Skokholm there appears to have been a 43% decline from 3,500 AOS in 1995 (Vaughan & Gibbons 1996) to 2,000 AOS in 2001 (Vaughan 2001), as determined by two identical playback surveys. This decline may be a long-term trend since at least the late 1960s when Scott (1970) estimated 5,000 – 7,000 AOS, although his methods were not comparable with playback. Perrins (1997) suggested that the colony on the nearby island of Skomer may have also declined at some point during the latter half of the 20th century. However, more recently, between 1981 and 2000, during six repeated playback surveys conducted at several sub-colonies on Skomer numbers remained stable at 100-120 pairs, before extra survey effort in 2001 and 2003 found additional sub-colonies that increased the island's total to around 200 pairs (Brown and Easton 2000, J. Brown unpubl.).

Gannet *Morus bassanus*

The gannetry on Grassholm (Pembrokeshire) is the only one in Wales but is the third largest in the world. During Seabird 2000 an aerial survey counted 30,688 AOS in 1999 (Murray 2000), but subsequently a repeat survey in 2004 found that the colony has

increased in size by 4.6% (or 0.7% per annum) to 32,094 AOS, around 8% of the world population (Wanless *et al* .2005a, 2005b) The size of the colony has increased steadily throughout the 20th century, but most rapidly since the 1940s (Fig. 2). In the last 35 years aerial surveys found 16,128 AOS in 1969-70, 28,600 AOS in 1984 and 27,500 AOS in 1991

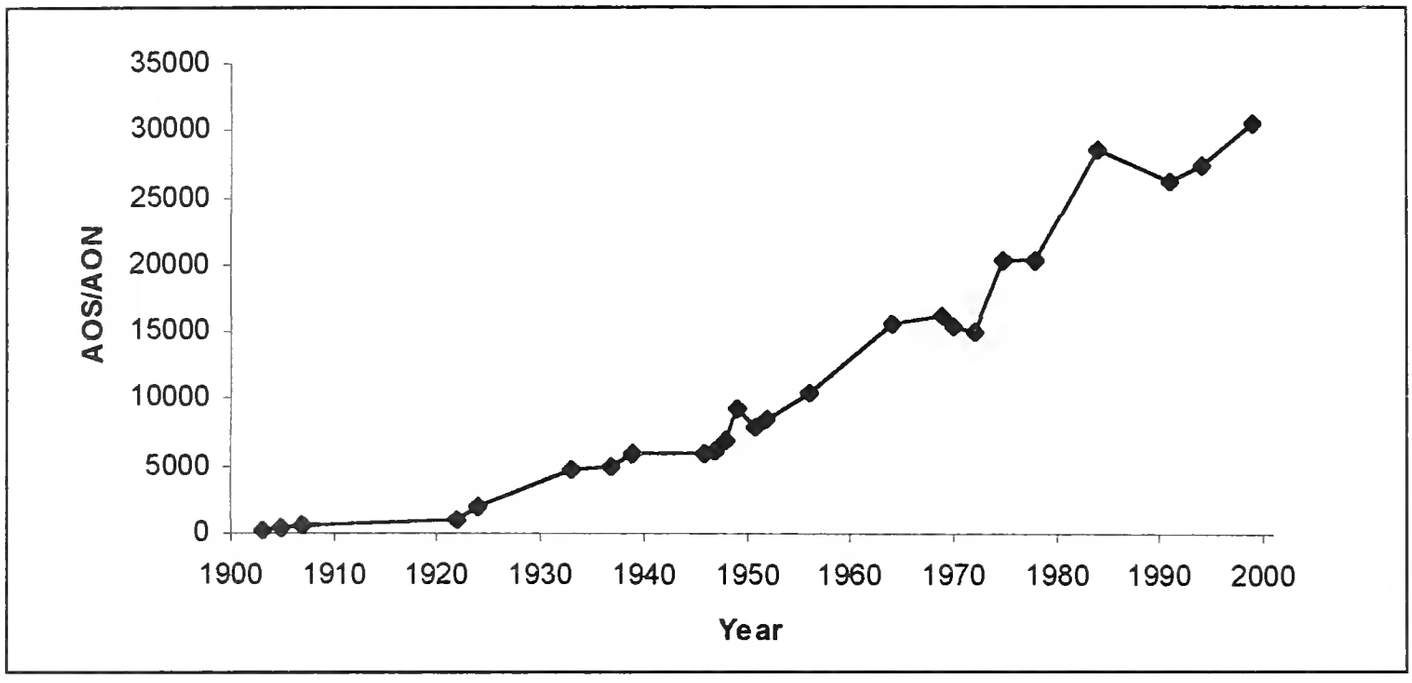


Figure 2. Changes in the number of Gannets (AOS) on Grassholm 1900-2000

and probably a similar number in 1994, though the difficulties in interpreting aerial photographs used for the 1994 survey limited the accuracy of the estimate. Comparisons of aerial photographs taken in 1984, 1991, 1994 and 1999 suggested that the extent of the colony (and therefore breeding numbers) remained stable between 1984 and 1994 (Murray & Walsh 1992, Murray 2000); however, this is difficult to determine from photographs alone and observations from RSPB wardens on the ground at the time suggest that the extent of the colony was in fact expanding eastwards (G Williams, pers.comm). Indeed, ground-truthing conducted in conjunction with aerial surveys in both 1999 and 2004, show that the colony has continued to expand slightly along the north-eastern edge (Wanless *et al.* 2005a). RSPB's annual sample counts of productivity (i.e. number of nests with chicks) were consistently high from 1993 to 2002, from 60% and 57% in 1993 and 1994 to 79% and 77% in 2001 and 2002 with a maximum of 86% in 1998 (Ian Bullock, pers.comm.).

Cormorant *Phalacrocorax carbo*

Wales holds 20% of Cormorants breeding in Britain at just 14% of the colonies (Figure 3) including the two largest colonies in Britain, at Little Ormes Head, Caernarfon (428 AON in 2001) and on Puffin Island, Anglesey (353 AON in 2001). There is just one inland colony (65 AON in 1999) in Wales, established in 1695 at Craig yr Aderyn, Meirionnydd. There have been four full surveys of breeding Cormorants in Wales prior to Seabird 2000 (Table 3). Total numbers in Wales increased through the 1970s, 1980s and peaked in the mid 1990s but have since declined so that numbers in 1998-2002 were 16% higher than in 1969-70 but similar to that in 1985-88 (Table 3). The slight fall in breeding numbers that occurred between 1994 and 1996, was not considered to be a result of mortality following the *Sea Empress* oil spill disaster off the Pembrokeshire coast in February 1996 and was probably caused by non-breeding by some pairs as a

response to cold northerly winds in early April and May 1996 (Sellers & Hughes 1996). Breeding success was also thought to be more affected by the cold temperatures, rather than the oil spill. The decrease in numbers since 1996 was partly attributable to a notable decrease on Puffin Island, Anglesey, from 776 AON in 1996 to 353 AON in 2001. Otherwise, declines have been most evident at colonies in the south in Ceredigion and Pembrokeshire, where on St Margaret's Island, formerly one of the largest colonies in Wales, numbers declined from 295 AON in 1990 (Donovan & Rees 1994) to only 69 AON in 2000, but with a recovery to 189 pairs in 2004 (Mavor *et al.*2005).

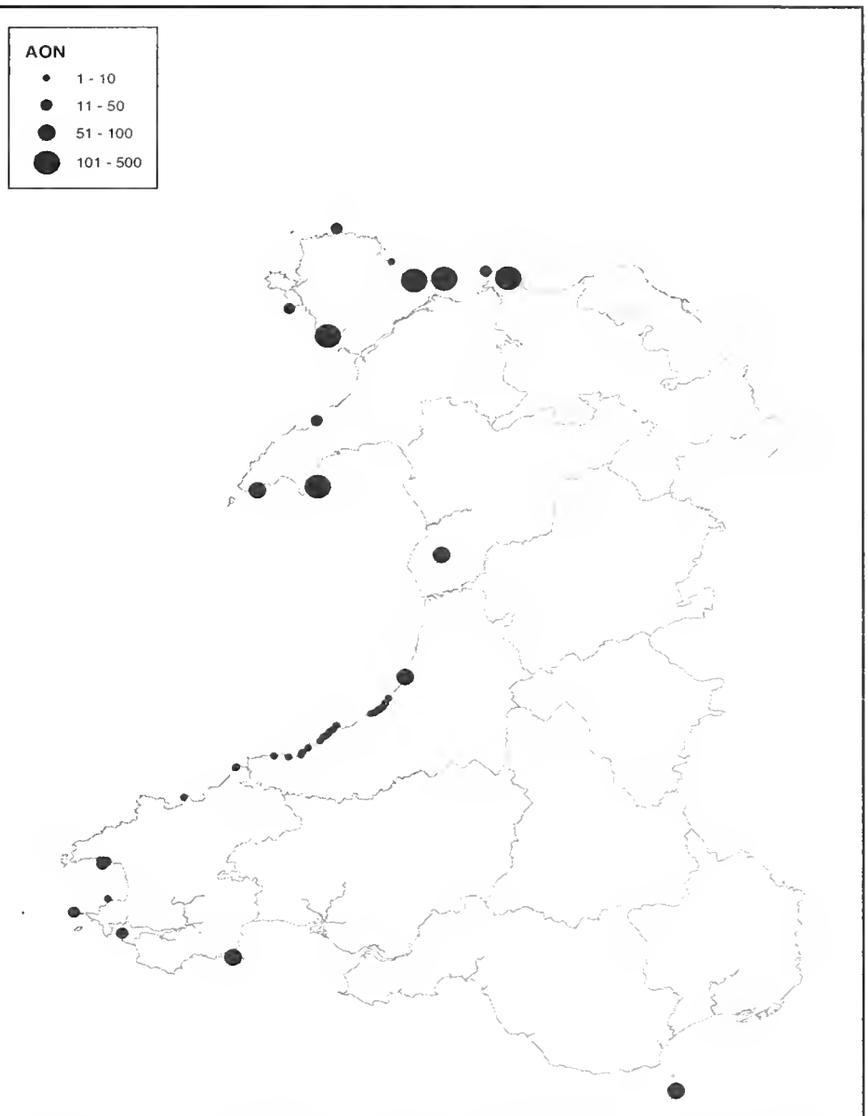


Figure 3. Abundance and distribution of breeding Cormorants in Wales 1998-2002

Table 3. Numbers of breeding Cormorant (AOS) in Wales 1969-2002.

Watsonian Vice-county	*Operation Seafarer (1969-70)*	*SCR Census (1985-88)*	*1994*[1]	*1996*[2]	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*
Caernarfon	415	472	674	620	683	65	45
Anglesey	390	560	949	1012	683	75	22
Meirionnydd	45	57	68	57	65	44	14
Ceredigion	180	274	206	164	103	-43	-62
Pembroke	380	362	391	316	165	-57	-54
Glamorgan	10	0	0	0	0	-100	
Gwent	0	0	0	0	89[c]		
Wales total	1,410	1,725	2,291[a]	2,182[b]	1,788	27	4
Great Britain, Isle of Man & Channel Islands total	6,060	6,302	-	-	8,549	41	36

[1] Source: Sellers (1994)
[2] Source: Sellers & Hughes (1996)
[a] Includes a count of 3 AON from a colony at location which was withheld by Sellers (1994) at the request of the Landowner, so could not be assigned to a vice-county
[b] Includes a count of 13 AON from a colony at location which was withheld by Sellers & Hughes (1996) at the request of the Landowner, so could not be assigned to a vice-county
[c] Denny Island, Gwent was not surveyed during Seabird 2000 but Green (2001) gives a count of 89 AON in 2000 after first being colonised in 1999.

Shag

Phalocrocorax aristotelis

Wales holds low numbers of Shags, just 3% of the British population, scattered amongst many cliff-nesting seabird colonies from Anglesey to Pembrokeshire, with a single pair on the Gower peninsula, Glamorgan (Fig. 4). The largest colonies are in Caernarfon, with 194 AON on the Bardsey archipelago (Ynys Enlli, Ynys Gwylan Fawr and Bach) and 114 on St Tudwal's Islands. Numbers of Shags nesting in Britain have declined by 25% since 1985-88, having increased prior to that since 1969-70 (Table 4). This decline has largely occurred in Scotland, whereas in Wales, numbers have continued to increase since 1985-88 by around 1.1% per annum, which is also in stark contrast to trends in colonies on the other side of the Irish Sea, with numbers in Ireland having declined by 27% since 1985-88.

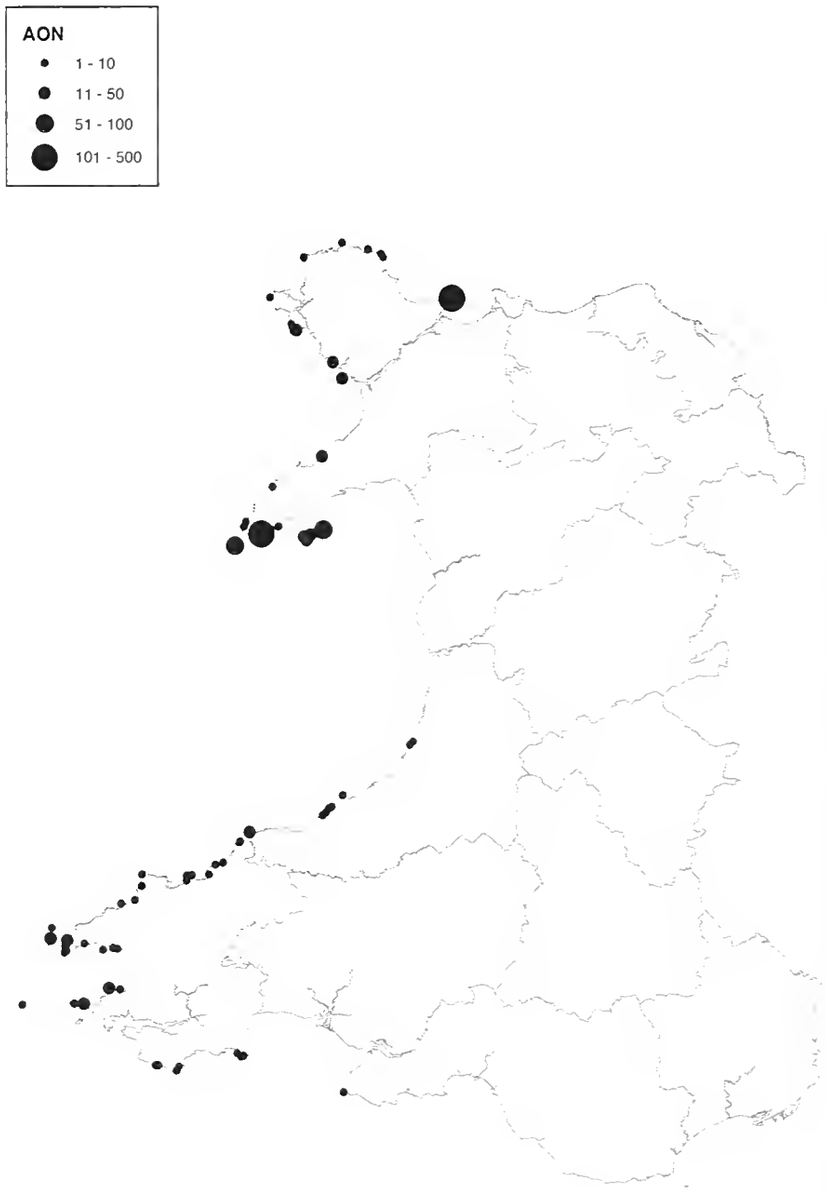


Figure 4. Abundance and distribution of breeding Shags in Wales 1998-2002

Table 4. Numbers of breeding Shags (AOS) in Wales 1969-2002.

Watsonian Vice-county	*Operation Seafarer (1969-70)*	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*
Caernarfon	200	378	382	91	1	0.0
Anglesey	170	239	301	77	26	2.0
Ceredigion	45	63	39	-13	-38	-4.0
Pembroke	150	104	191	27	84	5.0
Glamorgan	2	1	1	50	0.0	0
Wales total	567	785	914	61	16	1.1
Great Britain, Isle of Man and Channel Islands total	30,875	37,854	28,579	-7	-25	-2.1

Black-headed Gull *Larus ridibundus*

Prior to Seabird 2000 there have been three complete national surveys of breeding Black-headed Gulls, in 1938 (Hollom 1940), 1958 (Gribble 1962) and 1973 (Gribble 1976); while Operation Seafarer (1969-70) surveyed only coastal colonies and coverage of inland colonies in the SCR Census (1985-88) was incomplete (Table 5, 6). Numbers of

Table 5. Numbers of breeding Black-headed Gulls (AOS) in Wales 1938-2002.

	1938[1]	*1958*[2]	*1969-70*[3]	*1973*[4]	*1985-88*[5]	*1998-2002*
Coast	585	585	800	182	1002	850
Inland	5,193	4,124	-	8,382	2,008	1,136
Total	*5,778*	*4,709*	-	*8,564*	*3,010*	*1,986*
% on coast	10	12	-	2	33	43
% inland	90	88	-	98	67	57

[1]Source: Hollom (1940); mid-points of minima and maxima given
[2]Source: Gribble (1962); mid-points of minima and maxima given
[3]Source: Cramp *et al.* (1974); inland colonies were not surveyed
[4]Source: Gribble (1976); mid-points of minima and maxima given
[5]Source: Lloyd *et al.* (1991); survey of inland colonies was incomplete

Table 6. Numbers of breeding Black-headed Gulls (AOS) in Wales 1985-2002.

	coastal colonies only						
Watsonian Vice-county	*Operation Seafarer (1969-70)*	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*	*Seabird 2000 inland and coastal*
Flintshire	0	52	0		-100	-100.0	158
Denbighshire	0	0	0				244
Caernarfon	0	0	0				46
Anglesey	115	903	840	630	-7	-1.0	840
Meirionnydd	700	47	0	-100	-100	-100.0	0
Ceredigion	0	0	10				213
Pembroke	22	0	0	-100			0
Carmarthen	0	0	0				15[1]
Glamorgan	0	0	0				75
Montgomery	0	0	0				158
Brecon	0	0	0				82
Radnor	0	0	0				170
Wales total	837	1,002	850	2	-15		2,001
Great Britain and Isle of Man total	72,168	72,602	73,289	2	1	0.1	127,907

[1]Though not surveyed during Seabird 2000, Green (2001) recorded 15 pairs breeding at the Penclacwydd Wildfowl and Wetlands Trust reserve in 2000

Black-headed Gulls breeding in Wales increased some time after 1958 to 7,956-9,172 pairs (min-max) in 1973, but have declined by around 77% since then (Table 5). The decline has occurred mainly at inland colonies, including the abandonment of the largest colony at Llyn Trawsfynydd (Meirionnydd) that held 1330 AON in 1986. In 1998-2002, 57% of Black-headed Gulls in Wales nested at inland colonies, with just two established

Table 7. Comparison of Black-headed Gull breeding occurrence in OS 10-km squares Wales and in Britain during Seabird 2000 (1998-2002) and the Atlas surveys in 1968-71 (Sharrock 1976) and 1988-91 (Gibbons *et al.* 1993).

	1968-72 Atlas	1988-91 Atlas	Seabird 2000 (1998-2002)	S2000 new squares	S2000 extinct squares	Percentage change since 1968-72	Percentage change since 1988-91
Wales	69	55	27	5	32	-61%	-51%
Britain total	827	671	333	73	411	-60%	-50%

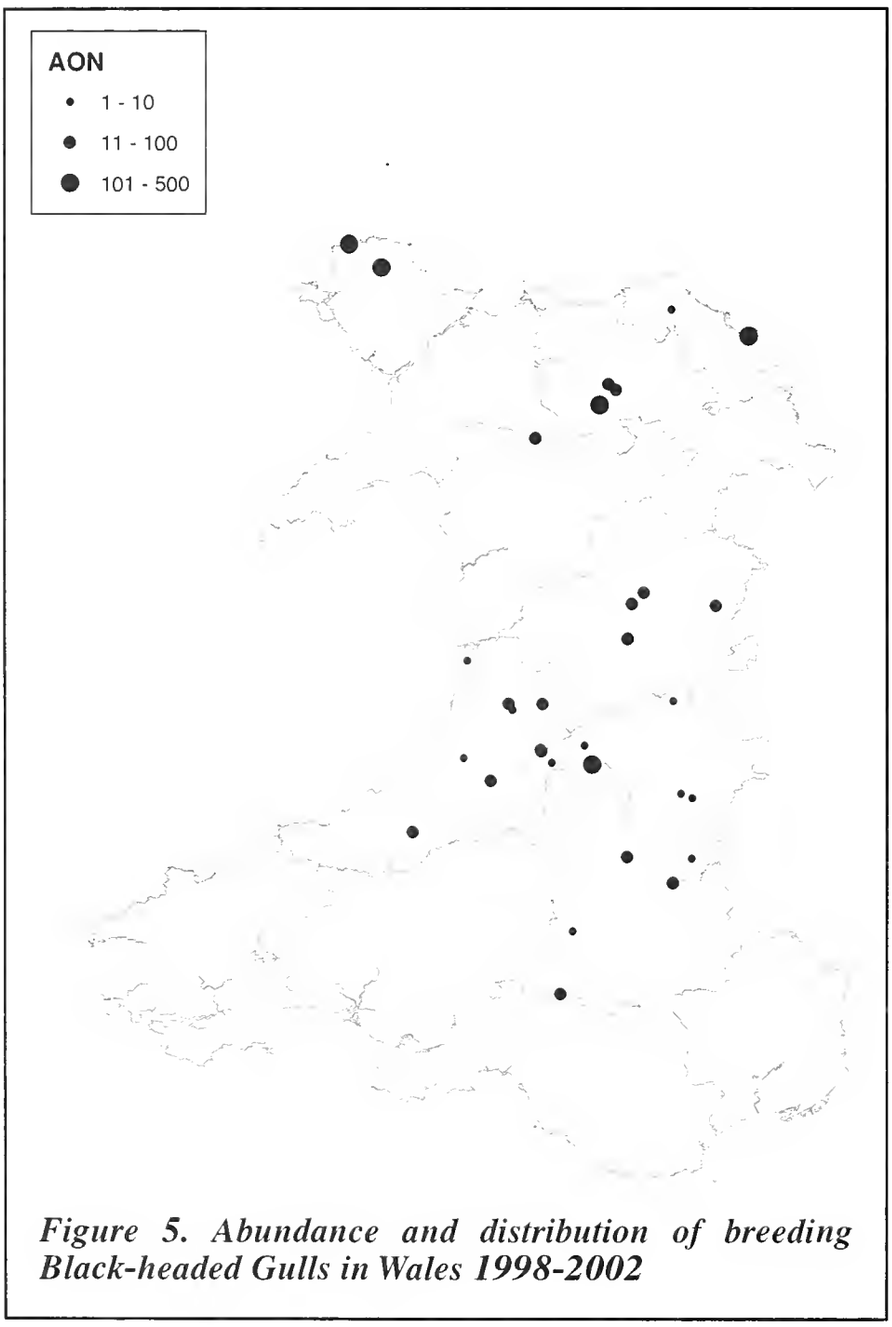


Figure 5. Abundance and distribution of breeding Black-headed Gulls in Wales 1998-2002

coastal colonies: Llyn Alaw (400 AON) and Cemlyn (440 AON), both on Anglesey and a further 10 pairs attempted to breed at Cors Fochno (Dyfi NNR), Ceredigion in 2000. Table 7 compares the number of 10km squares in Wales that were occupied by breeding Black-headed Gulls during Seabird 2000 (see Figure 5) with that during the Atlas of Breeding Birds in Britain and Ireland surveys in 1968-71 (Sharrock 1976) and in 1988-91 (Gibbons *et al.* 1993). The number of occupied squares in Wales has decreased by 51% since 1988-91 and by 61% since 1968-71, which is very similar in extent to the shrinking distribution in the rest of Britain (Table 7). However, unlike in Wales, increases in the size of coastal colonies in England appear to be buffering the declines inland (Dunn 2004).

Lesser Black-backed Gull *Larus fuscus*

Just under one fifth of the British population of Lesser Black-backed Gulls nest in Wales, concentrated in the south, with around two thirds in Pembrokeshire (Table 8, Figure 6). The total number of Lesser Black-backs breeding in Wales almost doubled between 1969-70

Table 8. Numbers of breeding Lesser Black-backed Gulls (AON) in Wales 1969-2002.

	Coastal colonies only						
Watsonian Vice-county	*Operation Seafarer (1969-70)*	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*	*Seabird 2000 inland and coastal*
Flintshire	0	0	24			1000	24
Denbighshire	9	7	3	-67	-57	-5	3
Caernarfon	6	273	696	11,500	155	7	706
Anglesey	3,700	1,610	857	-77	-47	-4	857
Meirionnydd	0	0	3				3
Ceredigion	9	376	1,678	18,544	346	12	1,678
Pembroke	5,700	15,631	13,910	144	-11	-1	13,910
Glamorgan	1,100	2,096	3,475	216	66	3	3,475
Gwent	10	50	36[1]	260	-28	-2	65
Brecon	0	0	0				1
Wales total	10,534	20,043	20,682	79	3	0.2	20,722
Great Britain, Isle of Man and Channel Islands total	48,352	62,750	88,228	77	41		111,835

[1] The colony at Denny Island, Gwent that held 48 AON in 1986 was not surveyed during Seabird 2000

and 1985-88 but was similar in 1999-2002, in contrast to the rest of Britain where total numbers have continued to rise during the late 1980s and 1990s (Table 8). Numbers on Anglesey have been in decline since Operation Seafarer in 1969-70, firstly with the abandonment of the colony at Newborough Warren in 1982 (2,095 AON in 1969) and the subsequent abandonment of the colony at Bodorgan Head (also known as Pen y Parc, 740 AON in 1987) some time between 1996 (386 pairs – Jones & Whalley 2004) and 2001 (none present during the Seabird 2000 survey). Both sites were also abandoned by larger colonies of Herring Gulls around the same time, suggesting both species were affected by similar factors (see below)

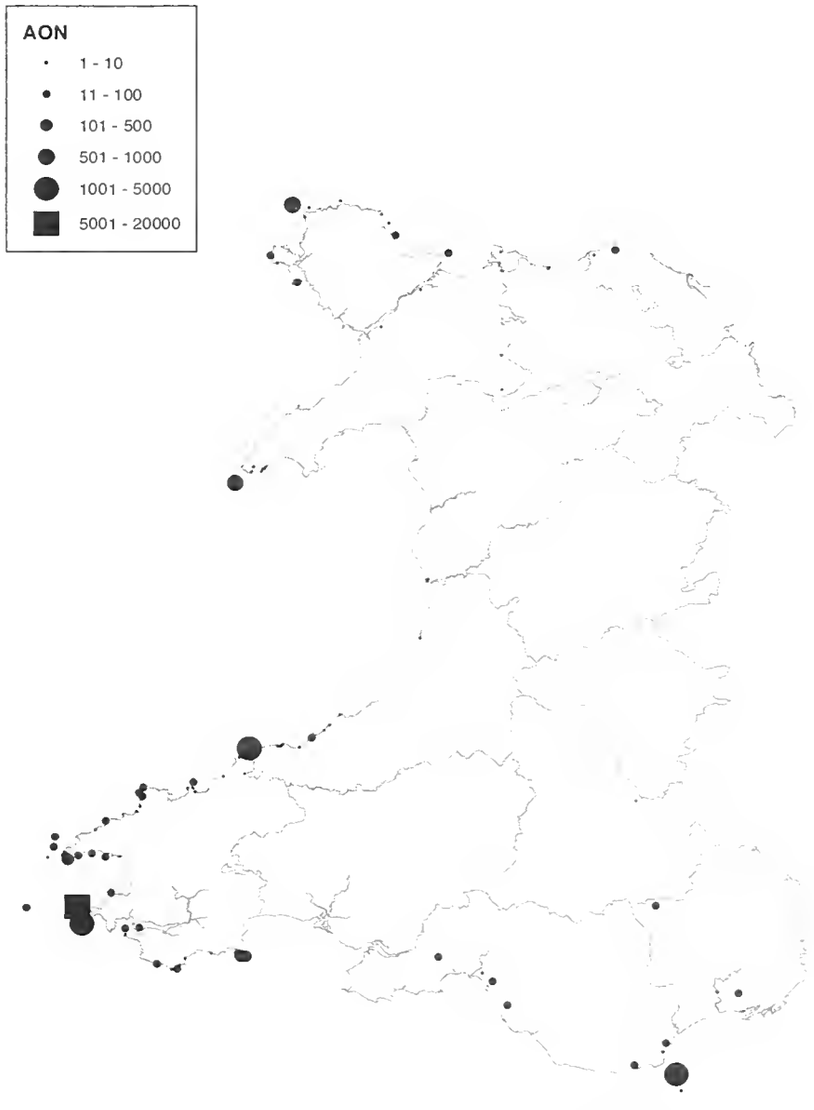


Figure 6. Abundance and distribution of breeding Lesser Black-backed Gulls in Wales 1998-2002

Around half of the Welsh population of Lesser Black-backs nest on Skomer, the third largest colony in Britain, with 10,007 AON in 2000 (given in Mitchell *et al.* 2004), plus 3,462 empty nests in the same year, equating to a total of 13,469 pairs (Brown *et al.* 2004). The size of the colony on Skomer increased throughout the 1960s and 1970s, but increased more slowly in the 1980s, probably a direct effect of a cull of 4000 adults during 1981-87, which aimed to reduce the level of gull predation on auks and waders (Perrins & Smith 2000). Despite the cull, numbers of Lesser Black-backs peaked in 1993 at 20,200 pairs (including empty nests), but subsequently numbers have declined steadily. The decline in numbers on Skomer has coincided with a period of poor productivity (1989-2003) and a significant decline in adult survival or increase in emigration (1987-1997) (Perrins & Smith 2000, Brown & Wilberforce 2003, Brown *et al.* 2004). The declines in adult survival appear to be coincident with declines in whitefish discards from French trawlers in the southern Irish Sea from the late 1980s onwards and appear to have resulted in Lesser Black-backs switching from feeding at sea to feed on earthworms on pastureland (Perrins & Smith 2000). Other large colonies exist on nearby Skokholm (2,429 AON), Flat Holm, Glamorgan (3,309) and on Cardigan Island (1,648 AON).

The number of roof-nesting Lesser Black-backed Gulls in Wales is relatively small compared to the rest of Britain, and has not shown the same dramatic rise in numbers that has occurred in Britain since the first urban gull survey by Monaghan & Coulson (1977) in 1976 (Table 9). The majority of roof-nesters in 1976 were in Cardiff (156 AON) but they have since disappeared from the city centre and are now confined to the Alexandra Docks (56 AON in 2002).

Table 9. Numbers of roof-nesting Lesser Black-backed Gulls (AON) in Wales 1976-2002.

Watsonian Vice-county	*1976*[1]	*1993-95*[2]	*1999-2002*	*Percentage change since 1976*	*Percentage change since 1993-95*
Flintshire		6	24		300
Denbighshire			2		
Caernarfon		6	34		467
Anglesey		3			
Meirionnydd			1		
Ceredigion			1		
Pembroke			94		
Glamorgan	189	172	166	-12	-3
Gwent	9	13	65	622	400
Brecon		1			
Total	198	201	387	95	93

[1] Source: Monaghan & Coulson (1977)
[2] Source: Raven & Coulson (1997)

Herring Gull *Larus argentatus*

The Herring Gull is now less numerous in Wales than the Lesser Black-backed Gull, but is much more widespread (Figures 6 & 7), exploiting roof-top nesting sites and quarries along sections of coast devoid of natural sites such as sea-cliffs. Numbers of Herring Gulls in Wales declined dramatically by 37,487 AON or 77.2% between 1969-70 and 1985-88 (Table 9). This was largely due to a large reduction in numbers on Anglesey, where numbers at the largest colony in Wales on Puffin Island plummeted from around 15,500 AON in 1969

to only 919 AON in 1986; while colonies were abandoned at Newborough Warren in 1982 (4,785 AON in 1969/70) and at Carmel Head (2,900 AON in 1969). Declines in Herring Gull numbers during the 1970s occurred throughout the rest of Wales and indeed, the rest of Britain where numbers fell by 50% (Table 10). Declines in Anglesey during the 1970s and 1980s have been attributed to botulism, to the introduction of Foxes (*Vulpes vulpes*) in the 1970s and to the closure of rubbish tips (Jones & Whalley 2004). Degradation of nesting habitat due to canopy closure in the forestry plantation at Newborough Warren was the main cause for abandonment of the colony there; and culling contributed to the decline on Puffin Island

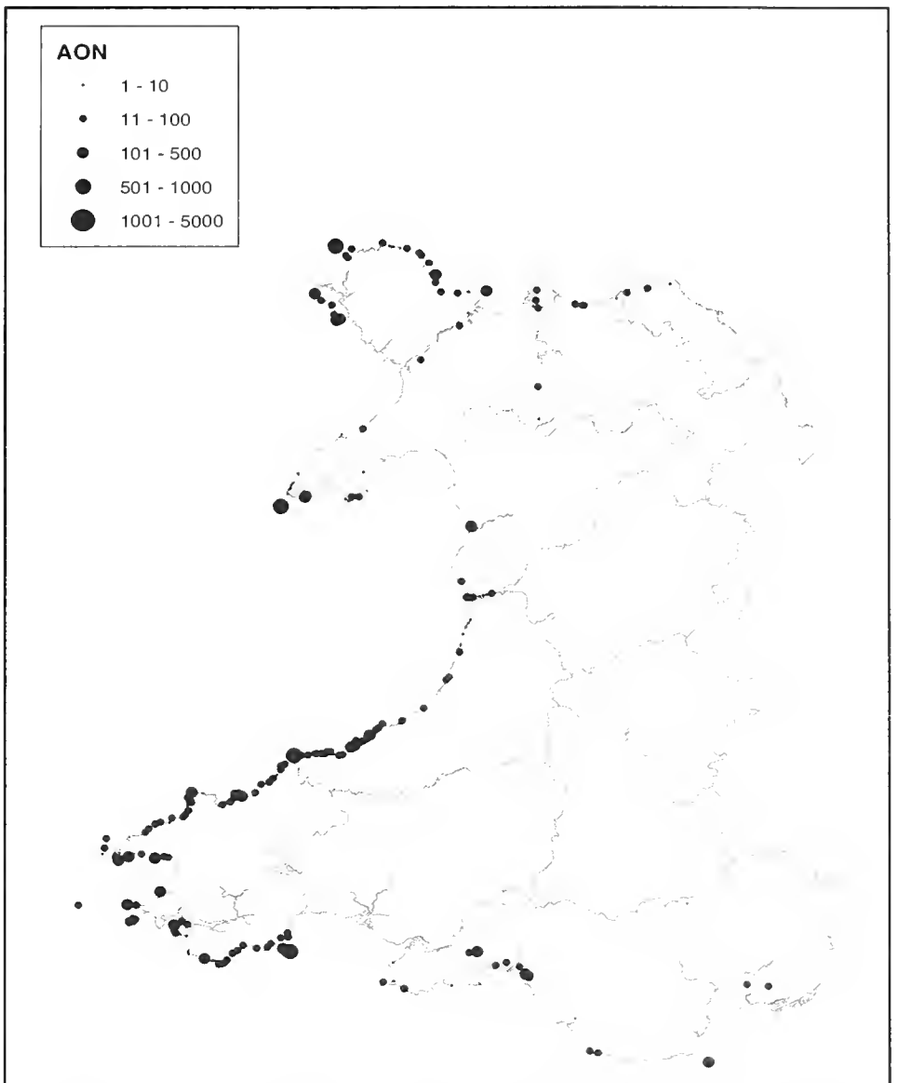


Figure 7. Abundance and distribution of breeding Herring Gulls in Wales 1998-2002

Table 10. Numbers of breeding Herring Gulls (AON) in Wales 1969-2002.

	Coastal colonies only						
Watsonian Vice-county	*Operation Seafarer (1969-70)*	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*	*Seabird 2000 inland and coastal*
Flintshire	0	15	119		693	14	119
Denbighshire	700	96	79	-89	-18	-1	79
Caernarfon	1,900	988	1,547	-19	57	3	1,583
Anglesey	29,900	3,942	2,369	-92	-40	-3	2,369
Meirionnydd	300	130	508[a]	69	291	10	508
Ceredigion	3,000	1,495	2,186	-27	46	3	2,186
Pembroke	12,700	3,743	6,238	-51	67	4	6,238
Carmarthen	180	4	0[b]	-100	-100	-100	0
Glamorgan	1,500	651	816	-46	25	1	816
Gwent	200	25	68[c]	-66	172	7	76
Wales total	50,380	11,089	13,930	-72	26	1.6	13,974
Great Britain, Isle of Man and Channel Islands total	283,874	144,249	140,994	-50	-2	-0.2	142,942

[a] The Colony at Friog Cliffs, Meirionnydd (47 AON in 1986) was not surveyed during Seabird 2000
[b] Colonies at Telpyn Point and Gilman Point, Carmarthen that eaeh held 2 AON in 1987 were not surveyed during Seabird 2000.
[c] The Colony at Denny Island, Gwent (48 AON in 1986) was not surveyed during Seabird 2000

Since 1985-88, numbers have increased by 2,841 AON or 25.6%, due mainly to an increase on Caldey Island, Pembrokeshire of 684 to 2,134 AON, now the largest Herring Gull colony in Wales. There were increases at the other largest colonies on Bardsey Island (205 to 663 AON), Cardigan Island (700 to 746 AON) and the Skerries, Anglesey (361 to 840 AON). Other large colonies declined, such as on Puffin Island, Anglesey (919 to 400 AON) and the long-established colony at Bodorgan Head which had survived the declines on the rest of Anglesey during the 1970s (1,150 AON in 1969 and 1,110 AON in 1987) was abandoned. Changes in Herring Gull numbers on Skomer are well documented (see Perrins & Smith 2000), having increased through the 1960s to 2,200 AON and remained fairly stable through the 1970s, before declining dramatically in the early 1980s to just 645 AON in 1984, with just 367 AON in 2000. The changes in breeding numbers on Skomer appear to be more a result of changes in adult survival/emigration rather than low levels of recruitment due to low breeding success (Perrins & Smith 2000). Herring Gulls from Skomer, unlike Lesser Black-backs, did not scavenge behind trawlers at sea, but fed close inshore, including Milford Haven fish docks which closed in the 1970s, and many gulls will have switched to feeding on rubbish tips. During the major decline in the early 1980s many gulls on Skomer where found to have died from botulism, caused by the bacterium *Clostridium botulinum*, contracted at rubbish tips. Botulism has been attributed as one of the causes of the decline in Herring Gull numbers throughout Britain in the last 30 years and is thought to be responsible for the massive 90% decline in Ireland that has occurred since 1969 (Mitchell *et al.* 2004). Improved exclusion measures at rubbish tips have forced many gulls to feed away from tips and onto fields and inter-tidal areas.

Domestic and commercial waste in urban areas has provided an important food source for Herring Gulls in towns and also safe nest sites on roof-tops where 10% of Herring Gulls breeding in Wales now nest (Table 11). Numbers of urban gulls in Wales declined between the two previous surveys of roof-nesting gulls in Britain in 1976 (Monaghan & Coulson 1977) and 1993-95 (Raven & Coulson 1997), due to the demise of Herring Gulls in Cardiff where 425 pairs nested in 1976; and an aerial survey of Glamorgan in

Table 11. Numbers of roof-nesting Herring Gulls (AON) in Wales 1976-2002.

Watsonian Vice-county	*1976*[1]	*1993-95*[2]	*1999-2002*	*Percentage change since 1976*	*Percentage change since 1993-95*
Flintshire		123	112		-9
Denbighshire	7		58	729	
Caernarfon	260	217	295	13	36
Anglesey		12	9		-25
Meirionnydd		60	260		333
Ceredigion		6	53		783
Pembroke		25	15		-40
Glamorgan	591	310	475	-20%	53%
Gwent	69	19	76	10%	300%
Total	927	772	1353	46%	75%

[1] Source: Monaghan & Coulson (1977)
[2] Source: Raven & Coulson (1997)

2002, as part of Seabird 2000 found none nesting in the capital. Herring Gulls are also now absent from the towns of the Valleys, including former roof-top colonies in Merthyr Tydfil and Hirwaun. However, numbers on roof tops elsewhere in Glamorgan have increased, with 167 AON at Waunarlwydd and 265 AON at 4 colonies in and around Port Talbot in 2002. The main area for roof-nesting by Herring Gulls in Wales is in the coastal

towns of Meirionnydd (e.g. 82 AON in Aberdyfi and 101 AON in Barmouth), Ceredigion (53 AON in Aberystwyth), Caernarfon (e.g. 71 AON in Bangor, 76 AON in Conwy and74 AON in Llandudno) and Denbighshire (e.g. 61 AON in Prestatyn and 51 AON in Rhyl), where total numbers have more than doubled since 1993-95 (Table 11).

Great Black-backed Gull *Larus marinus*

1% of the British population of Great Black-backs breeds in Wales. They are distributed widely along rocky stretches of coastline in single pairs or in small colonies less than 10 pairs, with the largest colonies occurring on offshore islands such as Skomer (61 AON), Skokholm (53 AON), Middleholm (34 AON) and Ynys Gwylan Fawr (61 AON) (Figure 8). There were two instances of nesting inland during 1998-2002, with single pairs at Llyn Elsi, Caernarfon and Llyn yr Adar, Meirionnydd. Total numbers breeding in Wales declined by 68% between 1969-70 and 1985-88, but since then numbers have recovered partially (Table 12). On Skomer, numbers of Great Black-backs peaked at 183 pairs in 1962, but declined due to active management controls in the 1970s and botulism in the early 1980s to a low of 25 pairs in 1984. There were no records of roof-nesting by Great Black-backs in Wales during Seabird 2000, and the only previous record is of one pair nesting on the roof-top of the Old College in Aberystwyth in 1998 (H. Roderick pers. comm..).

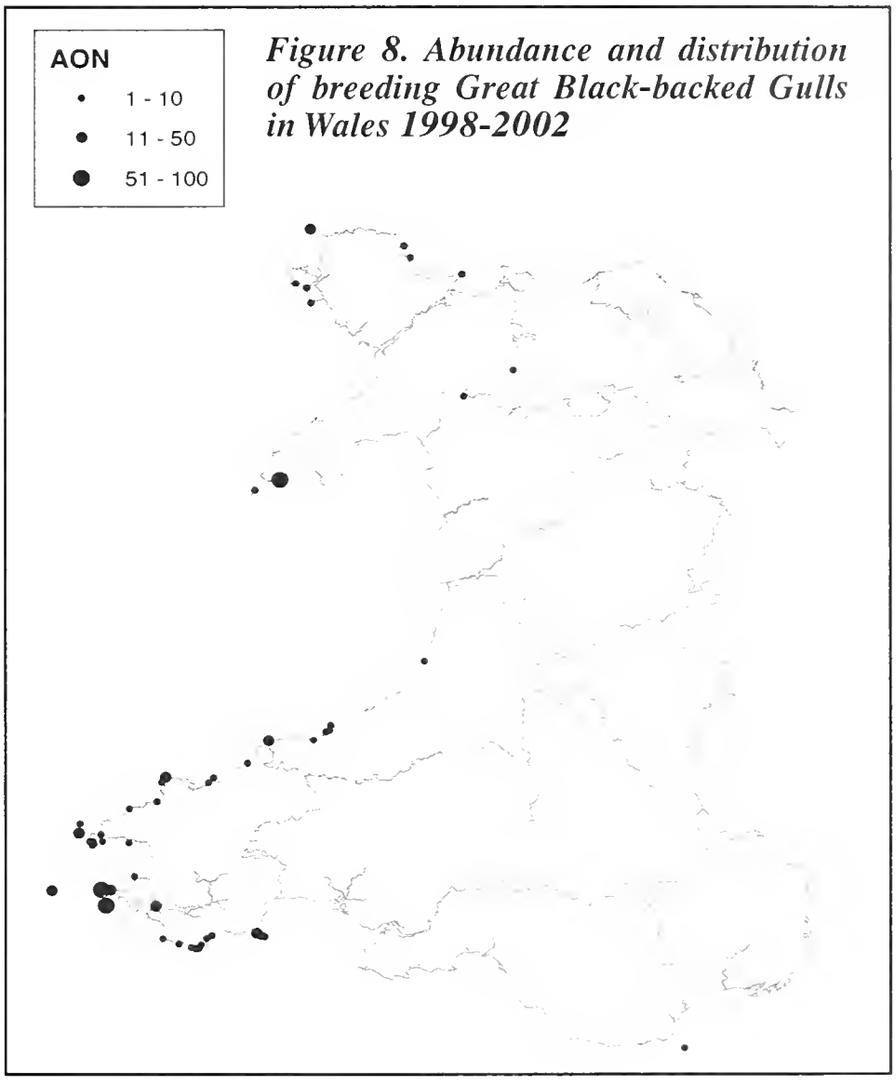


Figure 8. Abundance and distribution of breeding Great Black-backed Gulls in Wales 1998-2002

Table 12. Numbers of breeding Great Black-backed Gulls (AON) in Wales 1969-2002.

Watsonian Vice-county	*Operation Seafarer (1969-70)*	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*
Caernarfon	17	27	64	276	137	6.0
Anglesey	160	62	38	-76	-39	-3.0
Meirionnydd		4	1		-75	-9.0
Ceredigion	50	25	21	-58	-16	-1.0
Pembroke	680	164	301	-56	84	5.0
Glamorgan	2	0	2	0	0	
Gwent	33	10	0	-100	-100	-100.0
Wales total	942	292	427	-55	46	2.9
Great Britain, Isle of Man and Channel Islands total	19,006	17,693	17,394	-8	-2	-0.1

Kittiwake *Rissa tridactyla*

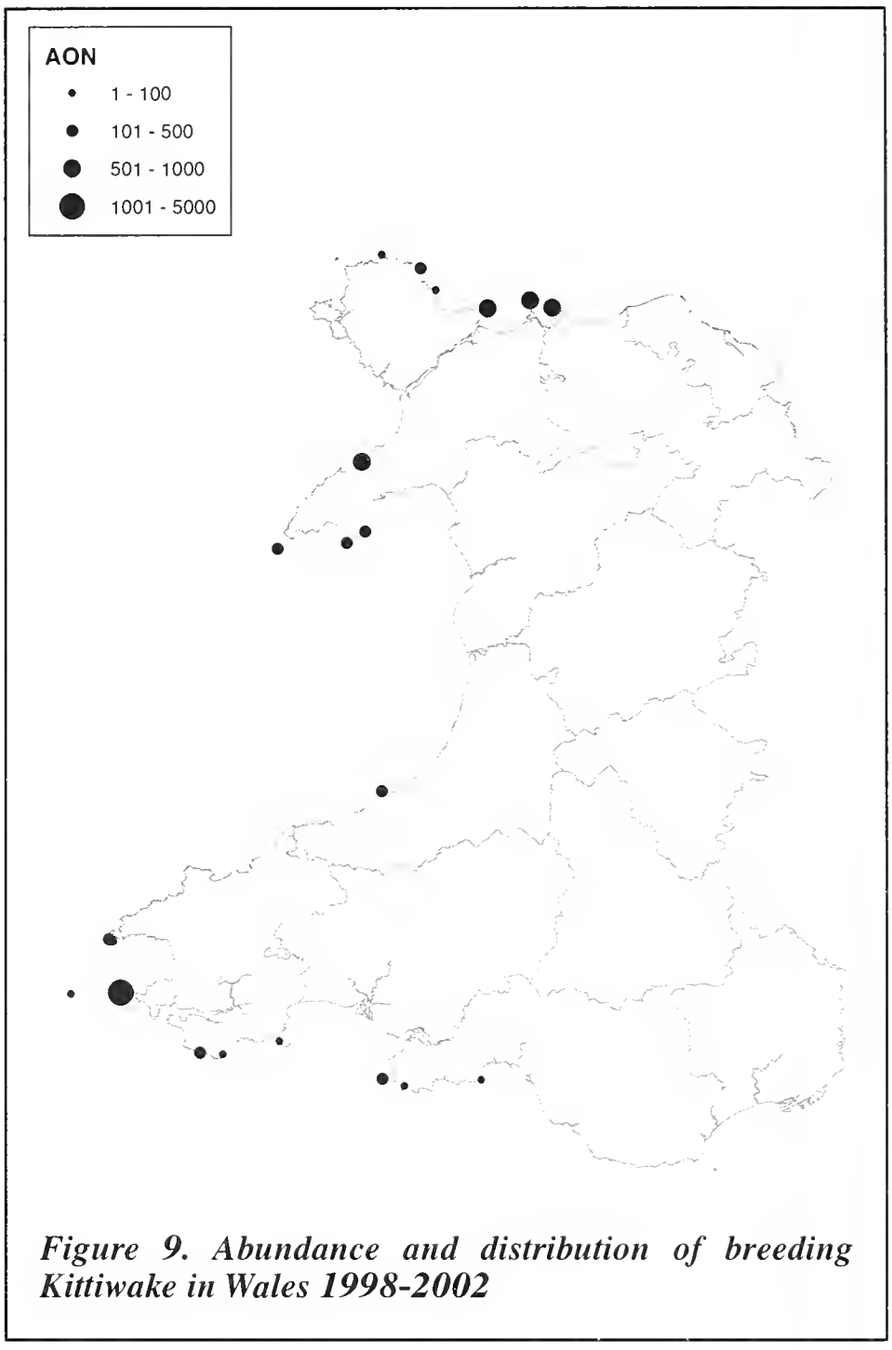


Figure 9. Abundance and distribution of breeding Kittiwake in Wales 1998-2002

Wales holds 2% of Kittiwakes breeding in Britain. The Welsh colonies are long-established on sea cliffs and their distribution has changed very little over the last 30 years (Figure 9). However, the colony at Llangrannog, Ceredigion which held 257 AON in 1987 was abandoned subsequently, but there was a corresponding increase in numbers at nearby New Quay Head. By far the largest colony is on Skomer (2,257 AON). Total numbers breeding in Wales have declined by 17% since the SCR Census (1985-88), slightly less than the 26% decline that occurred in the whole population of Britain (Table 13, Mitchell *et al.* 2004). Declines have occurred throughout Wales except in Anglesey where numbers have increased by over 50% (Table 13). Annual monitoring at four colonies that contain 45% of the total Welsh population suggests that there has been a fairly constant decline of 2.8% per annum between 1988 and 2002 (Mavor *et al.* 2003). Breeding success has also been monitored at the same colonies in most years since 1986 and the mean number of chicks fledged per nest during the period 1986-2002 was low at

Table 13. Numbers of breeding Kittiwakes (AON) in Wales 1969-2002.

Watsonian Vice-county	*Operation Seafarer (1969-70)*	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*
Caernarfon	2,230	3,663	2,950	32	-19	-2.0
Anglesey	940	596	930	-1	56	3.0
Ceredigion	60	432	375	525	-13	-1.0
Pembroke	2,960	3,745	2,813	-5	-25	-2.0
Glamorgan	560	335	225	-60	-33	-3.0
Wales total	6,750	8,771	7,293	8	-17	-1.3
Great Britain, Isle of Man and Channel Islands total	403,584	495,425	366,835	-9	-26	-2.2

all the colonies (Mavor *et al.* 2003): Bardsey Island, Caernarfon (0.72 se 0.12), Elegug Stacks, Pembrokeshire (0.32 se 0.07), Skomer (0.68 se 0.05) and Great Orme, Caernarfon (0.54 se 0.06). On Skomer, where the largest number of nests were monitored, there has been no discernible trend in breeding success since 1986 and there has been evidence in some years (e.g. 2001) that food availability during chick rearing has limited fledging success (Brown *et al.* 2004). Adult survival was also monitored annually on Skomer and while it has remained above 90% in most years since 1986, there was a period of successive years of low adult survival ranging 68-79% during 1994-97 (Brown *et al.* 2004). The reasons for the fall in adult survival are unclear but probably contributed to the decline in breeding numbers on Skomer.

The most unusual colony in Wales is that on the Mumbles Pier, Glamorgan. Established in 1992 (Hurford & Lansdown 1995), it contained 92 AON in 2000 and is the third largest colony of Kittiwakes nesting on a man-made structure in Britain.

Sandwich Tern *Sterna sandvicensis*

The single Welsh colony at Cemlyn, Anglesey has remained fairly stable between 1990 and 2000, fluctuating between 450 and 650 AON (Figure 10), in contrast to the population in Britain as a whole, which declined substantially during the mid 1990s due

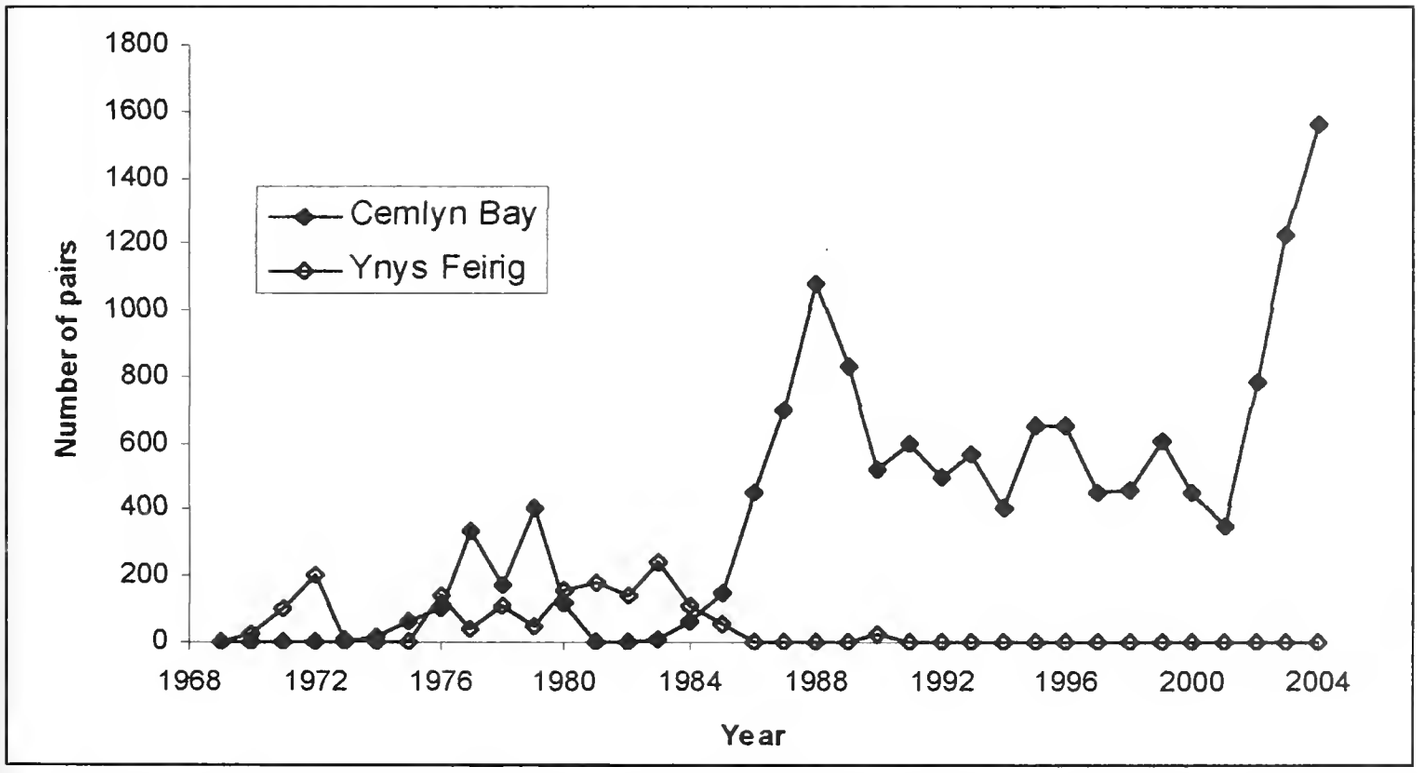


Figure 10. Changes in the number of Sandwich Terns (AON) on Anglesey 1986-2003. Source:RSPB.

mainly to predation by Foxes at some sites (Ratcliffe 2004a). Prior to the 1990s, numbers peaked in 1988 at 1,080 AON and more recently numbers have risen from a low of 349 AON in 2001 to 1,563 AON in 2004. The recent rise is in line with the overall trend in the British population (Mavor *et al.* 2005). Between 1969 and 1986, Sandwich Terns on Anglesey also nested at Ynys Feirig (Fig. 10).

The mean productivity of the Cemlyn colony was 0.83 (0.08 se) chicks fledged per pair during 1986-2004 and was the highest recorded for any of the colonies monitored regularly within Britain and Ireland (Mavor *et al.* 2005).

Roseate Tern *Sterna dougallii*

Anglesey once held the largest concentration of Roseate Terns in Britain and Ireland. Between 1969 and 1986, numbers on Anglesey fluctuated between 150-256 pairs, most of which were on Ynys Feirig, but regular breeding also occurred at Cemlyn and on Ynys Gorad Goch. In 1969 Anglesey held 8% of the combined population of Britain and Ireland. But as the number of Roseate Terns breeding in Britain and Ireland declined during the 1970s and 1980s, and the Anglesey population remained fairly stable, the relative importance of the Anglesey colonies grew so that by 1985 they held 40% of the British and Irish population (Figure 11). It was discovered that the decline in numbers of

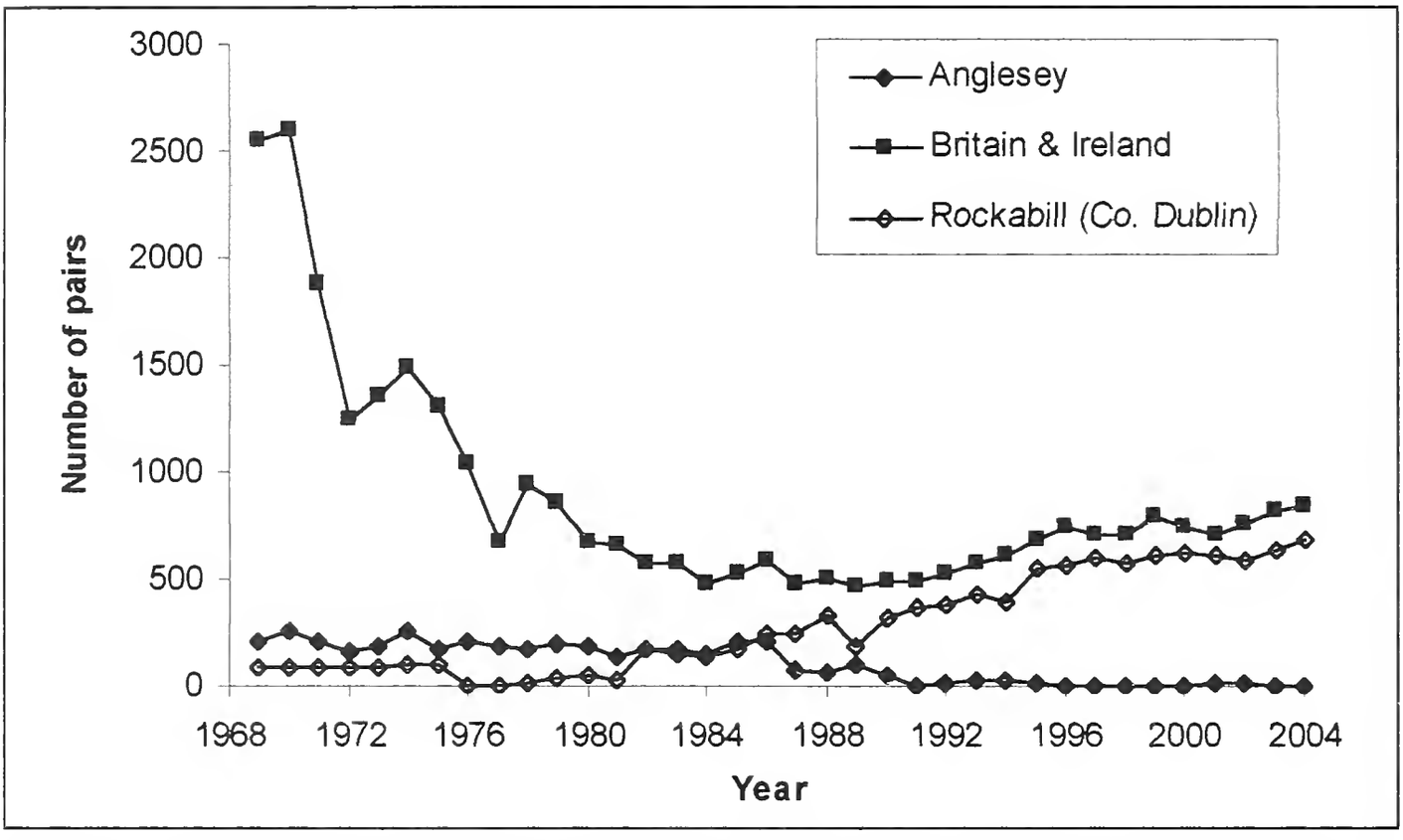


Figure 11. Changes in the number of Roseate Terns (AON) on Anglesey, on Rockabill (Co. Dublin, Rep. of Ireland) and in Great Britain and Ireland 1969-2003. Source: RSPB

Roseate Terns in Britain and Ireland was due to high levels of immature mortality on the wintering grounds in Ghana, west Africa where boys from fishing villages trapped terns for sport, food and sale (Ntiamoa-Badiu *et al.* 1992). An education programme was implemented in the late 1980s and early 1990s (Everett *et al.* 1987), which proved successful in reducing trapping rates (Ntiamoa-Badiu 1995) and immature survival rates increased subsequently and contributed to the population recovery that occurred through the 1990s (Ratcliffe *et al.* 1998b, Figure 11).

However, as the population decline in Britain slowed in the mid 1980s, numbers suddenly fell on Anglesey from 209 pairs in 1986 to 78 pairs in 1987 (Figure 11). This decline continued subsequently with just 1-7 pairs breeding annually between 1996 and 2003, and then none in 2004. Ringing has shown that the cause of the decline was emigration across the Irish Sea to breed at colonies along the east coast of Ireland (Ratcliffe *et al.* 1998b), namely the small island of Rockabill, Co. Dublin and at Lady's Island Lake, Co. Wexford. Figure 11 shows how numbers on Rockabill increased at the same time numbers on Anglesey declined. Rockabill now holds 78% of the population of Britain and Ireland and

over 26% of the European population (Newton 2004). Contrasting changes in numbers on both sides of the Irish Sea were caused by change in conditions at the breeding sites. Roseate terns have a relatively low rate of adult survival compared to other tern species, so must achieve a higher rate of productivity to maintain a population (Newton, 2004). During the late 1980s and early 1990s conservation measures were carried out to improve breeding conditions for Roseate Terns in the Republic of Ireland. Herring Gulls were culled on Rockabill and nest boxes were also installed on gravel terraces specially built onto the bare rock; while at Lady's Island, rat control, nest box provision and vegetation management improved conditions for nesting Roseate Terns. At both sites productivity increased (Avery *et al.* 1995, Cabot 1996). At the same time, the colonies on Anglesey experienced increased levels of predation and disturbance from a Fox (1987), Peregrines (*Falco peregrinus*) from 1980 onwards and gulls sporadically (see Lovegrove *et al.* 1994 for full details). There are now just over 50 pairs of Roseate Terns breeding in Britain, most of which are on Coquet Island, Northumberland (Newton 2004). It remains to be seen whether they will return to nest again on Anglesey where wardening and conservation measures are still in place on the prime sites.

Common Tern *Sterna hirundo*

Britain's fourth largest Common Tern colony is at the Shotton Steel Works, Flintshire. The colony was established in 1970 when the Merseyside Ringing Group established rafts on lagoons, but a colony existed prior to that on a saltmarsh nearby in the Dee estuary (Norman 1987). Numbers of Common Terns nesting at Shotton Steel Works (Figure 12)

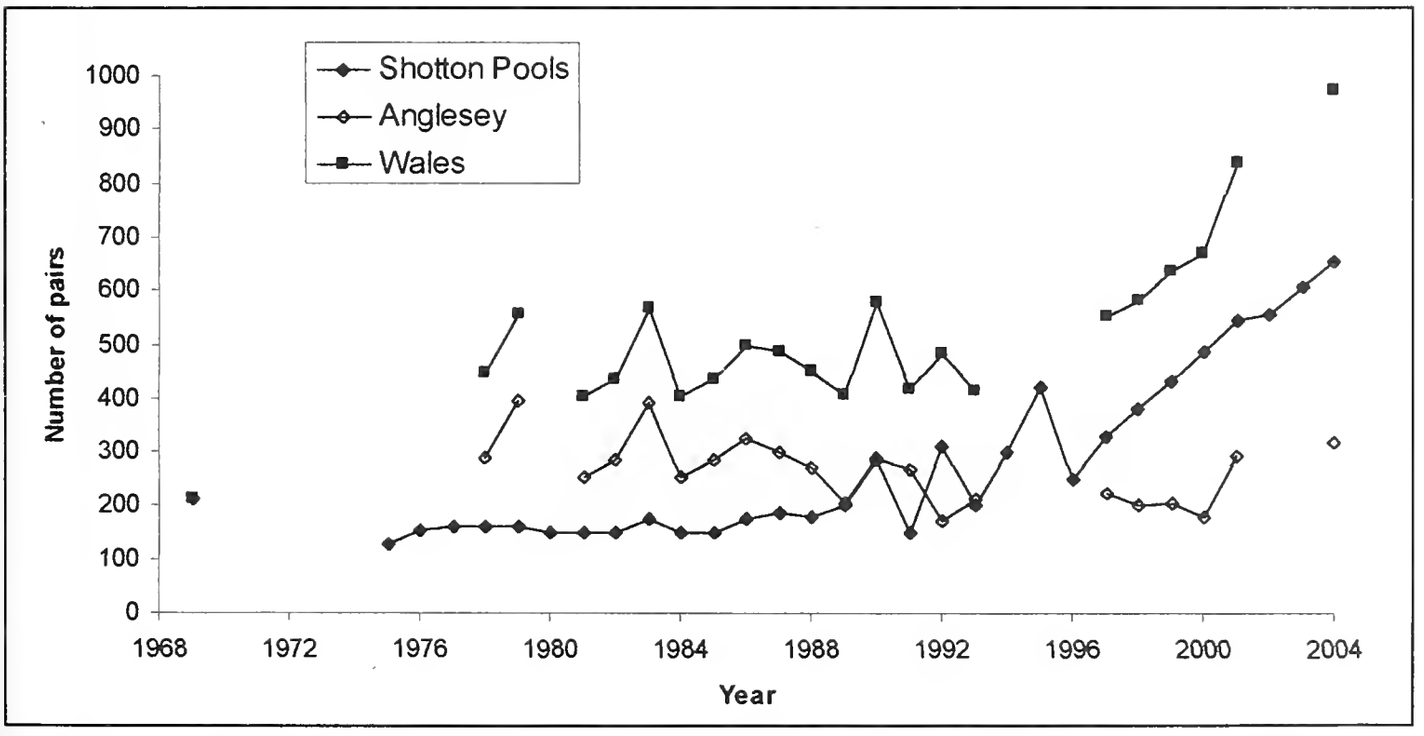


Figure 12. Changes in the number of Common Terns (AON) on Anglesey, at Shotton Pools (Flintshire) and in Wales 1969-2001. Source: RSPB

have increased in size consistently from year to year since 1996 to 490 pairs during the Seabird 2000 census in 2000 and 656 pairs in 2004 (Mavor *et al.* 2004). The only other colonies of Common Terns in Wales are on Anglesey, with counts in 2000 of 32 pairs at Cemlyn, 68 pairs on the Skerries and 80 pairs on Ynys Feirig; although numbers have subsequently increased at all sites with 72, 107 and 135 pairs respectively in 2004, with a further 7 pairs at the Inland Sea (Mavor *et al.* 2002). Several other colonies on Anglesey

have existed in the past. There were 141 pairs on an island in Llyn Alaw in 1969 but this colony became extinct around 1995. Ynys Gorad Goch was abandoned by Common Terns in 1999 for reasons that are unclear, though it may be no coincidence that numbers at Ynys Feirig and the Skerries increased around the same time.

The only colony outside Anglesey and Flintshire was at Llyn Trawsfynydd (Meirionnydd) during the late 1960s and early 1970s (Jones 1974). The absence of Common Terns from the rest of Wales and also south west mainland England (see Mitchell *et al.* 2004) is probably due to a lack of suitable nesting habitat. Common Terns require nesting sites to be free of mammalian predators, such as Foxes and Rats (*Rattus norvegicus*) and so usually breed on islands in inland water bodies or offshore, but are often excluded by overgrown rank vegetation or by competition with large gulls.

Arctic Tern *Sterna paradisaea*

Anglesey marks the south-western limit of breeding Arctic Terns in Britain and holds the only Arctic Tern colonies in Wales which are also amongst the largest in Britain outside Orkney and Shetland (which collectively hold 73% of the British population) (Mitchell *et al.* 2004). The majority of Arctic Terns on Anglesey breed at two colonies: the Skerries (1,368 pairs in 2000) and Ynys Feirig (335 pairs in 2000). Several pairs breed at Cemlyn and the Inland Sea, giving little indication of the former colonies at both sites where 649 pairs nested in 1977 and 540 pairs in 1975 respectively. Numbers of Arctic Terns on Anglesey have increased from 400 pairs in 1969 and 715-805 pairs in 1985-88 to 1,705 pairs in 2000 (Figure 13). Anglesey is one of the few areas in Britain where Arctic Terns

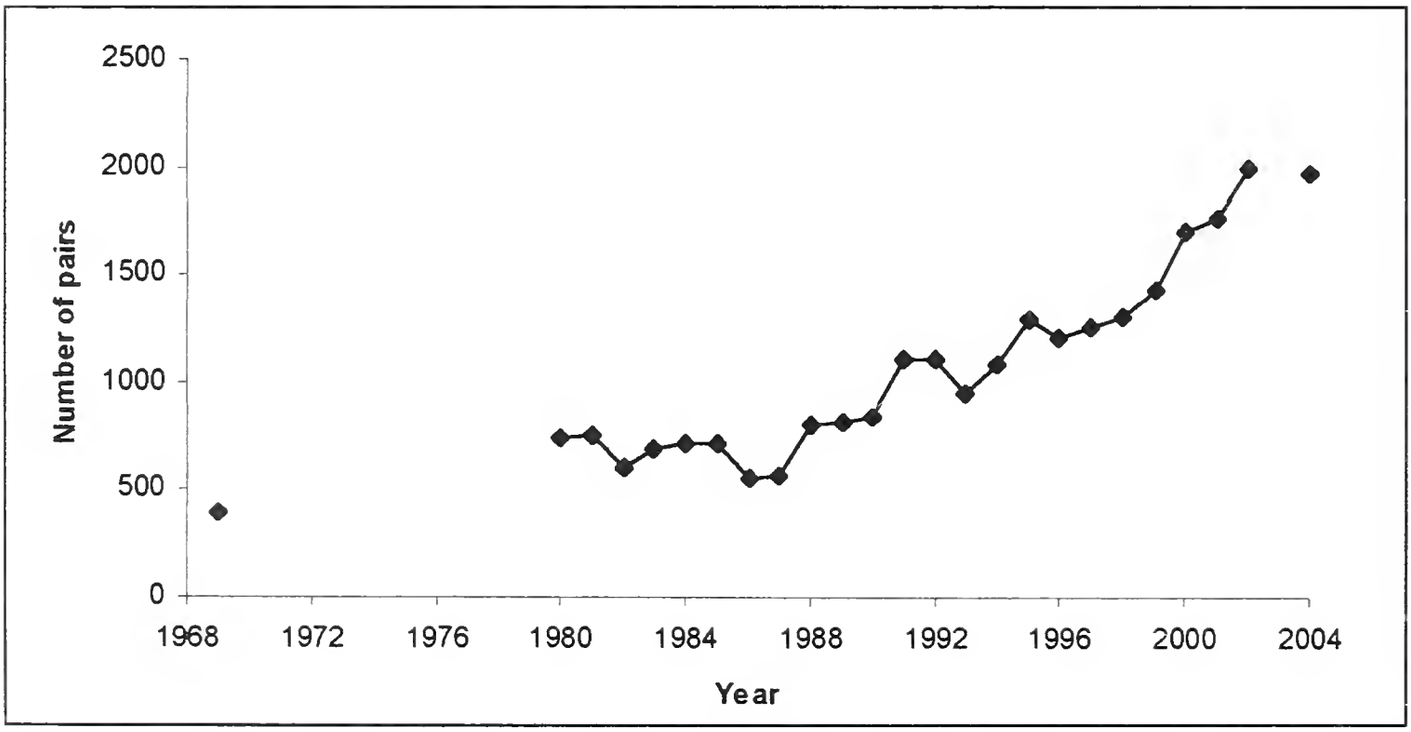


Figure 13. Changes in the number of Arctic Terns (AON) in Wales 1969-2002. Source: RSPB

have increased over the last 15-20 years and recent counts suggest that the increase in Arctic Tern numbers is continuing, with a total of 2000 pairs in 2002 (Mavor *et al.* 2003) and 1976 pairs in 2004 (Mavor *et al.* 2005). Since 1985-88 total numbers in Britain have declined by 31% and in Shetland and Orkney the total number of pairs declined by 41% between 1980 and 2000 (Mitchell *et al.* 2004).

The contrasting population trends on Anglesey and in the Northern Isles are linked to differences in breeding productivity between the two populations. On Anglesey, productivity at Ynys Feirig and the Skerries has been one of the highest in Britain since monitoring began in 1986 (Mavor *et al.* 2003), whereas low sandeel stocks around Shetland have led to successive years of poor breeding success and hence levels of recruitment that have been insufficient to maintain the population (Ratcliffe 2004b). In 2004, Arctic Terns on Orkney and Shetland experienced almost total breeding failure, whereas on Anglesey, an average of 0.49 chicks fledged per pair (Mavor *et al.* 2005).

Little Tern *Sterna albifrons*

There is just one colony of Little Terns in Wales at Gronant, Flintshire (in some years part of the colony has moved 5km along the coast to Point of Ayr). Numbers at Gronant/Point of Ayr (referred to as Gronant from now on) have increased steadily since 1969 from 3 pairs to 75 pairs in 2000 during Seabird 2000, and subsequently, 110 pairs in 2003, the highest count for the colony (Figure 14). The increase is in contrast

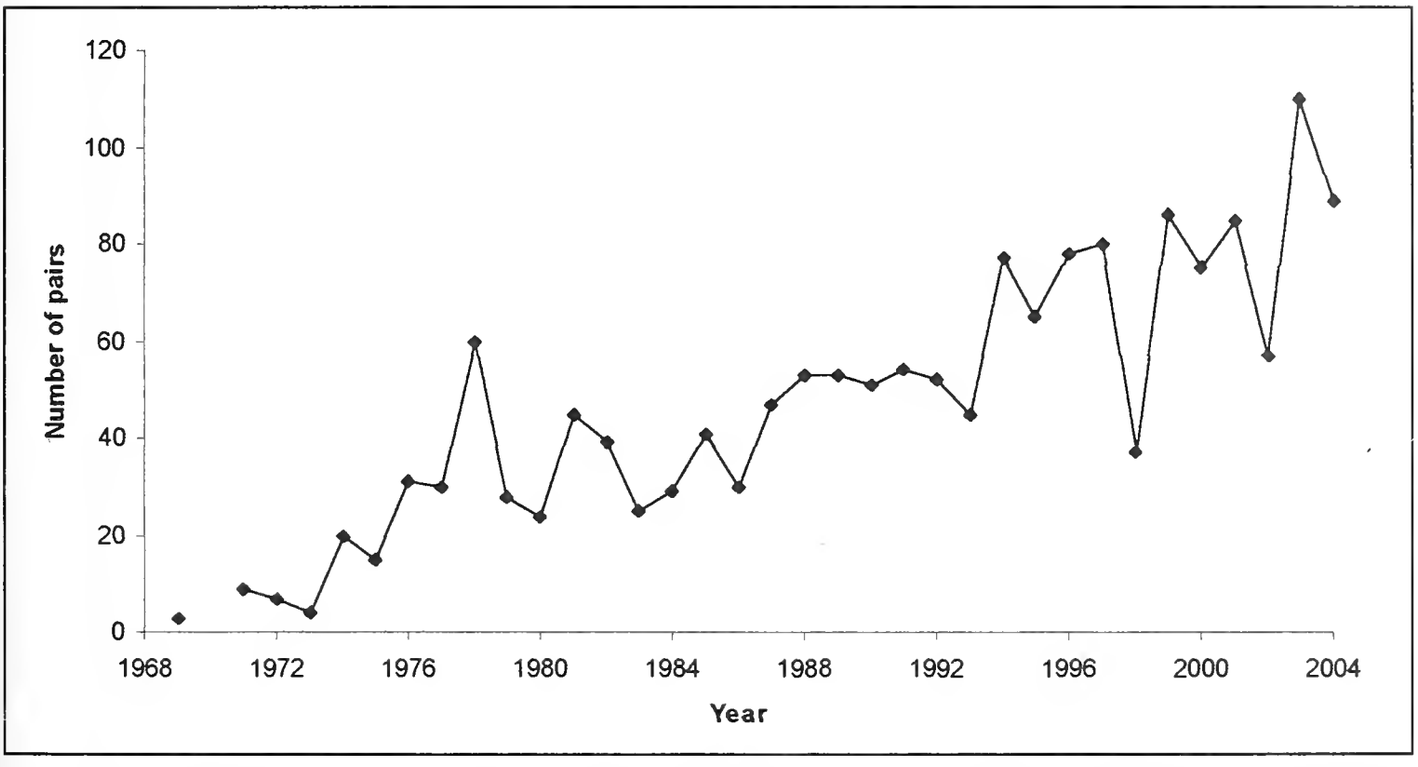


Figure 14. Changes in the number of Little Terns (AON) at Gronant, Flintshire 1969-2003. Source: RSPB

to the downward trend of the total population in Britain, which has declined by 24% since 1985-88. This decline in Britain can be explained almost totally by poor breeding success rather than any changes in adult survival or emigration (Ratcliffe *et al.* 2000, Pickerell 2004). Predation of chicks/eggs is the most common cause of reduced breeding success or complete failure at colonies. But at Gronant, breeding success has been on average the highest of all of the colonies monitored in Britain since 1986 (Mavor *et al.* 2003). This can be attributed at least in part, to intensive predator control measures implemented at the site by an RSPB warden since 1975. Measures include a perimeter fence to prevent human disturbance and an electric perimeter fence to exclude Foxes. Since the early 1980s, wardens have attended the colony 24 hours a day and actively scare off any aerial predators such as crows and kestrels (pers. comm. John Harrison).

Little terns have bred in smaller numbers at three other colonies in Wales during the past 30 years but all are now extinct: 1) Aber Dysynni (Tywyn), Meirionnydd – peaked at 36 pairs in 1977 and 1978, but was deserted from 1989 onwards. 2) Aber Dwyfor (west of Criccieth), Caernarfon – peaked at 9-11 pairs in 1975, but deserted from 1985 onwards (in 1975, 1980 and 1981, some pairs from the colony nested on the east side of Criccieth at Black Rock Sands). 3) Abermenai Point, Anglesey – peaked at 10 pairs in 1976, but deserted from 1980 onwards (in 1977 part of the colony moved across the Menai Straits to Dinas Dinlle, Caernarfon, where they nested most years up to and including 1988, with a peak of 15 pairs in 1987).

Guillemot *Uria aalge*

The population of Guillemots in Wales has almost doubled since the SCR Census in 1985-88 and is around three and half times what it was during Operation Seafarer (1969-70) but the distribution has changed little (Figure 15). The 80% increase or 4.4% per annum since 1985-88 is a higher rate of increase than observed in Britain as a whole (27%, 1.8% per annum, Table 14), probably because the Welsh colonies are smaller than those in Scotland where 75% of the British population is found, and smaller colonies tend to increase at a faster rate than larger ones (Harris & Wanless 2004). In fact, in the densest areas of Britain there is evidence that the rise in numbers appears to be slowing considerably with slight declines occurring in some areas (e.g. Orkney, Shetland; Mitchell *et al.* 2004, Mavor *et al.* 2005).

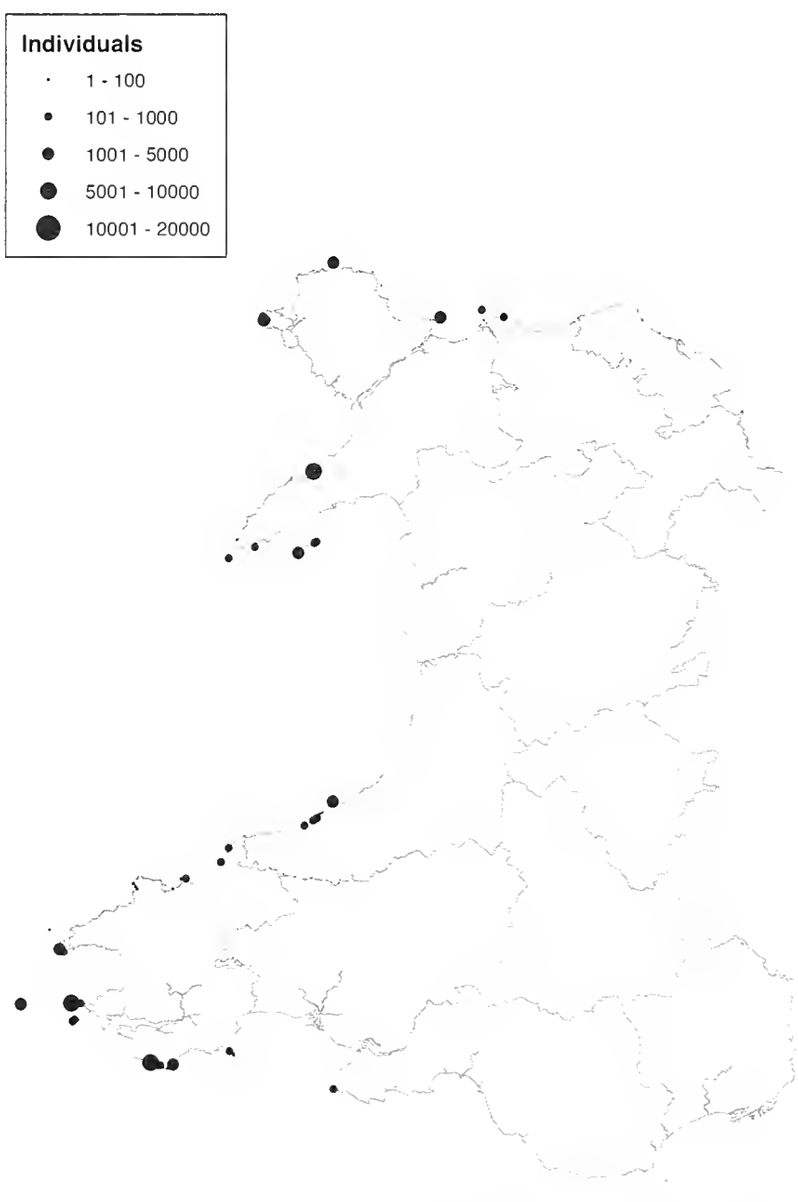


Figure 15. Abundance and distribution of breeding Guillemots in Wales 1998-2002

In Wales, the increase in numbers since the SCR Census (1985-88) has occurred throughout the country but have been more modest in Caernarfon where the majority breed in mainland cliff colonies at Carreg y Llam where numbers increased from 5,205 individuals in 1987 to 7,980 in 2000, whereas at Trwyn Cilan numbers decreased from 2,403 in 1986 to 2,100 in 2000. All other large colonies in Wales increased in size between the SCR Census and Seabird 2000. On Anglesey, numbers

Table 14. Numbers of Guillemots (Individuals) in Wales 1969-2002.

Watsonian Vice-county	*Operation Seafarer (1969-70)*[1]	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*
Caernarfon		10,641	12,707		19	1.0
Anglesey		4,628	9,152		98	5.0
Ceredigion		3,252	5,282		62	4.0
Pembroke		13,520	30,630		127	6.0
Glamorgan		85	190		124	6.0
Wales Total	17,238	32,126	57,961	236	80	4.4
Great Britain, Isle of Man and Channel Islands Total	504,764	1,038,834	1,322,830	162	27	1.8

[1] Cramp *et al.* (1974) gave Operation Seafarer counts of pairs only

at South Stack RSPB Reserve increased from 2,979 to 3,528, whereas two small island colonies on Puffin Island and Middle Mouse increased by 3-4 times from 872 to 2,799 and from 586 to 2,464 respectively. Further south, Ceredigion's largest colony at New Quay Head increased from 2,336 to 4,235. The Pembrokeshire colonies showed the greatest proportional increases and now hold over half of the population in Wales: numbers at Skomer more than doubled from 6,118 to 13,852 and numbers at Elegug Stacks and Ramsey Island increased from 3,553 to 6,817 and from 1,342 to 3,284 respectively. The only colony in Glamorgan is at Worms Head. Since Seabird 2000 the rise has continued at least at those colonies where annual counts are conducted (including Skomer, Elegug Stacks and South Stack) and an annual rate of increase of 5.9% has been measured between 1986 and 2004 (Mavor *et al.* 2005).

The population rise of Guillemots in Wales has persisted despite three major oil spill disasters which have affected Guillemots from Welsh colonies in the last eight years. On 15 February 1996 the oil tanker *Sea Empress* ran aground at the mouth of Milford Haven spilling 72,000 t of crude oil plus 360 t of bunker oil. On 23 February 1996 large numbers of auks returned to colonies throughout Pembrokeshire. Almost 2,000 oiled and dead Guillemots were recovered, the majority of which were adults (Weir *et al.* 1997), and many more are thought to have died but been washed away from the coast by currents and never recovered (Parr *et al.* 1997). The total number of Guillemots at monitored Welsh colonies in June 1996 was 11% lower than in 1995, bucking the upward trend that had occurred throughout Wales since at least 1986 (Thompson *et al.* 1997). The total number at colonies in south Pembrokeshire within the area affected by the spill was down by 17% (Parr *et al.*1997). Mean counts from monitoring plots in 1996 at Elegug Stacks had decreased by 11% since the previous year; no increase occurred in those on Skomer for the first time since 1990 and there was no significant change in those on Skokholm (Thompson *et al.*1997). The overall pattern of a decrease in numbers suggests an impact from the spill, but may have been in part due to a late breeding season following a cold spring that probably depressed counts of Guillemots and other seabirds attending colonies throughout Britain (Thompson *et al* 1997). In the year following the disaster, the number of Guillemots at monitored colonies in Wales was up by 12% compared to 1996 and numbers at most colonies in south Pembrokeshire appeared to have recovered, including significant

increases in the numbers attending monitoring plots at Elegug Stacks, on Skomer and on Skokholm (Thompson *et al.*1998, Seabird Colony Register database, JNCC/Seabird Group). The exception was on St. Margaret's Island where the number of Guillemots declined from 791 birds in 1995 to c.300 in 1996, with only 379 present in 1997, subsequently recovering slowly but steadily to 543 in 2004. In December 1999, 120,000 Guillemots were killed by the *Erika* oil spill off Britanny, many of which were immature birds from Welsh colonies. Numbers at Welsh colonies during the following summer were slightly lower than in the previous year and survival of adult Guillemots on Skomer between 1999 and 2000 fell by 10% to 85% compared to 95.6% in 1998/99 and 95% in 2000/01 (T. Birkhead unpublished report). Surprisingly, immature survival rates on Skomer during 1999-2001 were the highest in the 15 years that they had been monitored.

Productivity of Guillemots is measured only on Skomer and has remained high at an mean of 0.72 (0.01 se) chicks fledged per pair and has varied little from year to year between 1989 (when monitoring began) and 2004 . The productivity of Guillemots on Skomer has been similar to other colonies in Britain up until 2003, when colonies in Orkney, Shetland and NE Britain experienced a significant decrease in breeding success, followed by further decreases in 2004, when colonies in Shetland experienced unprecedented total breeding failure (Mavor *et al.* 2005). The poor productivity in the North Sea colonies in 2003 and 2004 appears to be due to a shortage of sandeels on which the Guillemots feed themselves and their chicks. No such food shortage has been experienced by Guillemots in Wales and on Skomer, for example, any drop in productivity is usually due to predation of chicks and eggs by Great Black-backed Gulls (Brown & Morgan 2004).

Razorbill *Alca torda*

Numbers of Razorbills in Wales have increased by a third since the SCR Census (1985-88) but had appeared to remain unchanged prior to that, following Operation Seafarer (1969-70) (Table 15). Breeding Razorbills are difficult to census and during Operation Seafarer, numbers were expressed as pairs, which makes it impossible to directly compare them to counts of individuals made during the SCR Census and Seabird 2000. The increase in Wales is double the rate observed in Britain as a whole (2.1% per annum compared to 1.0%, Mitchell *et al.* 2004). Monitoring of population plots at colonies

Table 15. Numbers of Razorbills (Individuals) in Wales 1969-2002.

Watsonian Vice-county	*Operation Seafarer (1969-70)*[1]	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*
Caernarfon		1,199	1,879		57	3.0
Anglesey		1,090	1,080		-1	0.0
Ceredigion		665	746		12	1.0
Pembroke		6,508	8,873		36	2.0
Glamorgan		39	60		54	3.0
Wales total	9,316	9,501	12,638	36	33	2.1
Great Britain, Isle of Man and Channel Islands total	126,719	144,117	164,557	30	14	1.0

[1] Cramp *et al.* (1974) gave Operation Seafarer counts of pairs only

which together hold 53% of the population in Wales, suggest a higher rate of increase of 3.8% per annum (Mavor *et al.* 2003). Total counts at these colonies during 1985-88 and 1999-2002 were as follows: Elegug Stacks (480 individuals in 1986, 713 in 2000), Stackpole Head (119 in 1987, 124 in 1999), Skokholm (702 in 1987, 1234 in 2000), Skomer (3,578 in 1985, 3898 in 2000) and South Stack RSPB Reserve (452 in 1987, 704 in 2000). Razorbill distribution in Wales is less aggregated than that of the Guillemot, particularly in Pembrokeshire where the majority are found, but the largest concentrations occur at the same places (Fig. 16), with other large colonies of Razorbills found on Ramsey Island (610 in 1987, 1499 in 2001) and at Carreg y Llam (387 in 1987, 445 in 2000).

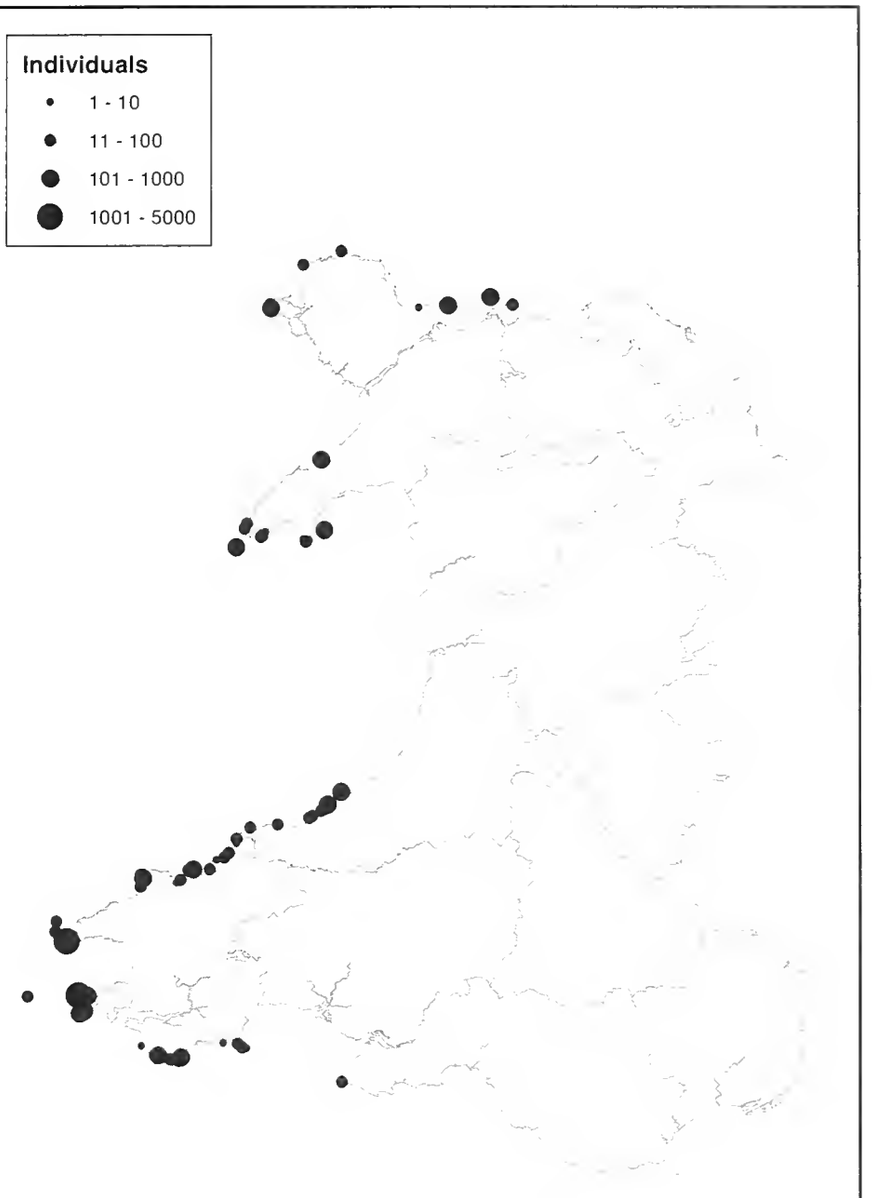


Figure 16. Abundance and distribution of breeding Razorbills in Wales 1998-2002

Productivity has been monitored on Skomer and Skokholm since 1993 and 1995 respectively. Mean productivity on Skokholm (0.84 se 0.03) is the highest of all six colonies monitored for Razorbill productivity in Britain during the period 1986-2003 (Mavor *et al.* 2004). Conversely, on Skomer, mean productivity (0.58 se 0.04) during the same period is the lowest in Britain (Mavor *et al.* 2004), following a decline between 1999-2003 (Brown *et al.* 2004), due in part at least to the loss of chicks in some areas of the island to predation from mainly Ravens (*Corvus corax*) and to a lesser extent, Herring Gulls (Birkhead & Hatchwell 2000). In 2004, there was no evidence at Welsh colonies that Razorbills had experienced the severe food shortages that resulted in complete breeding failure on Fair Isle and poor breeding success elsewhere in the Northern Isles (Mavor *et al.* 2005)

A total of 340 Razorbills were recovered dead following the *Sea Empress* oil spill off Milford Haven in February 1996 and possibly many more killed by the disaster but washed out to sea (Reid *et al.*1996). The total number of Razorbills at monitored Welsh colonies in June 1996 was 7% lower than in 1995, bucking the upward trend that had occurred throughout Wales since 1990 (Thompson *et al.* 1997). Mean counts of Razorbills in monitoring plots at colonies in south Pembrokeshire within the area affected by the spill had decreased significantly at both Skomer and Skokholm in 1996,

by 9% and 12% respectively compared to 1995, but there was no significant change at Elegug Stacks and at Stackpole Head (Thompson *et al.* 1997). Whole colony counts elsewhere in 1996 showed decreases at other colonies in south Pembrokeshire compared to 1995, most notably on Caldey and St. Margaret's Islands where total numbers fell by 65% to 116 birds. The overall pattern of a decrease in numbers suggests an impact from the spill, but may have been in part due to a late breeding season that probably depressed counts of Razorbills and other seabirds attending colonies throughout Britain (Thompson *et al.* 1997). In the year following the disaster, the number of Razorbills at monitored colonies in Wales was up by 5% compared to 1996 and numbers at most colonies in south Pembrokeshire appeared to have recovered, including a significant increase in the numbers attending monitoring plots at Stackpole Head, on Skomer and on Skokholm (Thompson *et al.* 1998, Seabird Colony Register database, JNCC/Seabird Group). As with Guillemots, the exception was on St.Margaret's Island and also on nearby Caldey Island where numbers in 1997 remained as low as in 1996, and even by 2004 the total number of Razorbills on the two islands (158) was still only around half what it was before the spill (Mavor *et al.* 2005). Large numbers of Razorbills from colonies in Britain and Ireland were killed during the two subsequent oil spill disasters in the Bay of Biscay, the *Erika* in December 1999 and the *Prestige* in November 2002, but of the birds recovered during both spills over two-thirds were immature (Camphuysen *et al.* 2002, B. Cadiou, pers. comm.). Indeed there was no depression in adult survival of Razorbills on Skomer in 2000 immediately following the *Erika* spill (96.8% in 2000, compared to 93.8% in 1999, T. Birkhead, unpubl.report) and numbers in monitoring plots on Skomer increased compared to 1999 and did so at other colonies in Wales (Mavor *et al.*2001). In 2003, following the *Prestige* spill, numbers on Skomer decreased by over 10% while other colonies continued to increase in size (Mavor *et al.* 2004).

Black Guillemot *Cepphus grylle*

The first pre-breeding survey in Britain was carried out during the SCR Census and then repeated during Seabird 2000. The total number of pre-breeding adults in Wales has changed little from 26 individuals in 1987 to 28 in 2002. Wales marks the south-western limit of breeding by Black Guillemots in Britain, in fact this was extended a further 70km in 2000 when a pair nested on Ynys Gwylan-fawr, south of the Llyn Peninsula, Caernarfon, now the only breeding pair in Wales outside Anglesey. Although Lovegrove *et al.* (1994) reported 2 pairs nearby on St Tudwals's Islands during the 1980s breeding was not proven. The population in Britain appears to have remained similarly unchanged during the same period. However an increase in Shetland has compensated for declines in north and west mainland Scotland, where the presence of mammalian predators such as Rats and Mink are thought to have reduced the amount of safe nesting sites available to Black Guillemots (Mitchell *et al.* 2004). On Puffin Island, Anglesey, a pair bred in 2002, four years after rats were eradicated from the island.

Puffin *Fratercula arctica*

Numbers of Puffins breeding in Wales appear to have declined slightly since the SCR Census (1985-88) (Table 16), in contrast to the rest of Britain where the numbers at some of the largest colonies on islands off the North Sea Coast, in Shetland and on along the Atlantic Frontier of NW Scotland have increased substantially (Harris 2004). Population trends are often difficult to determine due to the problems with surveying

Table 16. Numbers of breeding Puffins (pairs) in Wales 1969-2002.

Watsonian Vice-county	*Operation Seafarer (1969-70)*[1]	*SCR Census (1985-88)*	*Seabird 2000 (1998-2002)*	*Percentage change since Seafarer*	*Percentage change since SCR*	*Annual percentage change since SCR*
Caernarfon		603	1,053		75	4.0
Anglesey		209	103		-51	-5.0
Pembroke		10,301	9,170		-11	
Glamorgan		3	2		-33	-3.0
Wales Total	4,255	11,116	10,328	142.7	-7.1	-0.6
Great Britain, Isle of Man & Channel Islands Total	424,080	486,513	579,500	36.6	19.1	1.7

[1] Cramp *et al.* (1974) gave Operation Seafarer counts as an order of magnitude only

puffins at some colonies (see above). Operation Seafarer totals for the Watsonian vice-Counties are not shown in Table 16, since Cramp *et al.* (1974) gave estimates of orders of magnitude only.

Almost 99% of Puffins breeding in Wales are on just three islands. At the largest colony, on Skomer, numbers have increased slightly from 6,700 pairs during the SCR Census to 7,076 pairs during Seabird 2000. While on nearby Skokholm, numbers decreased from 3,582 pairs to 2,055 pairs. Counts of AOBs on Ynys Gwylan Fawr, Caernarfon increased from 504 AOB to 1,052 AOB. Numbers elsewhere appear to have changed little and there has been no apparent change in distribution, with three colonies on Anglesey - Puffin Island, South Stack and the Skerries - plus a scattering of several small colonies (<10 pairs) along the Pembrokeshire mainland coast and on the islands of North Bishop and St Margaret's; and 1-2 pairs remain at Worms Head, Glamorgan(Fig.17).

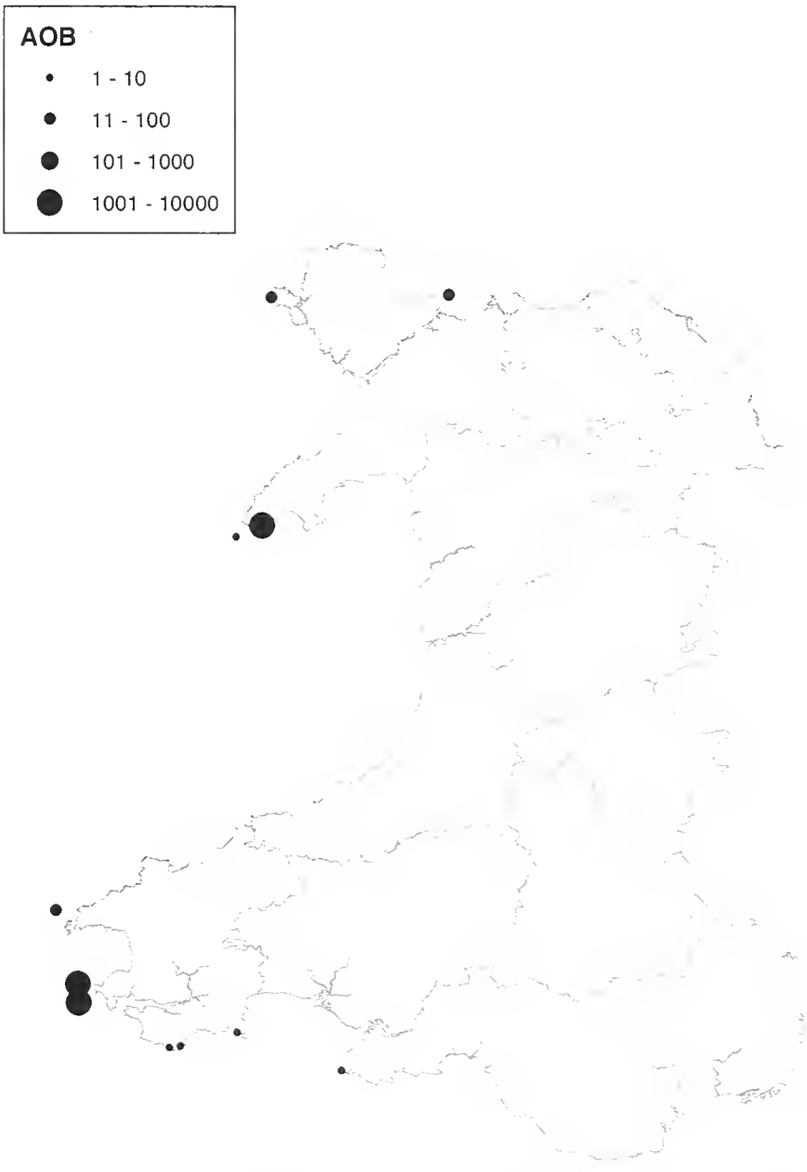


Figure 17. Abundance and distribution of breeding Puffins in Wales 1998-2002

DISCUSSION

Wales does not hold the huge numbers of seabirds that breed in other parts of the British Isles, due mainly to the limited amount of habitat available, namely high cliffs and offshore islands. However, where these do occur in Wales, particularly around Pembrokeshire, Caernarfon and Anglesey, the seabird colonies are rich in abundance and diversity. While offshore islands are not numerous, they are crucially free from mammalian predators and attract 'island specialists' such as Manx Shearwaters, Gannets and Storm Petrels in internationally important numbers.

A diversity of habitats in Wales ensures a diversity of breeding seabird species – 20 of the 25 species that breed in Britain and Ireland. Great Skuas (*Stercorarius skua*) and Arctic Skuas (*Stercorarius parasiticus*) are absent from Wales, most probably due to climate limitations, in that both have northerly distributions and are cold-adapted and thus sensitive to high summer temperatures (Furness 1987). This may also be true for Common Gulls (*Larus canus*), which have rarely nested in Wales (e.g. in 1969 single pairs bred in Herring Gull colonies on Anglesey at Newborough Warren, Bodorgan Head and Fedw Fawr, with 3 pairs at Penmon Quarry; Cramp et al. 1969; Seabird Colony Register Database, JNCC) and few in the British Isles breed outside Scotland, Northern Ireland and Co. Mayo, Republic of Ireland (Mitchell *et al.* 2004). Leach's Petrels (*Oceanodroma leucorhoa*) are also absent from Wales and are unlikely to ever colonise, since they require island nest sites that are close to their deep-water oceanic feeding areas; in Britain, they are confined to the islands of the Atlantic Frontier of NW Scotland (Mitchell 2004). The most recent addition to Britain's seabird assemblage is the Mediterranean Gull (*Larus melanocephalus*), which was first recorded breeding in Britain in 1968 on the south coast of England, but numbers did not start increasing beyond several pairs until the late 1980s and now there are over 100 pairs with breeding occurring as far north as Lancashire and Co. Antrim, Northern Ireland (Parsons 2004). Perhaps it won't be too long before Wales records its first pair of breeding Mediterranean Gulls.

The status of most species in Wales is encouraging, with numbers having increased since Operation Seafarer (1969-70) in 12 out of 17 species for which trends can be determined, and increased in nine out of 17 species since the SCR Census (1985-88). This compares with just eight and six species respectively in Britain as a whole (Table 17). The species that are most notably increasing in number in Wales, contrary to declines in the rest of Britain are Common, Arctic, Little and Sandwich Terns. However the number of sites occupied by each of these species has decreased as they have congregated at a few key sites where mammalian predators are either absent or are actively excluded and where, in some cases, aerial predators are also controlled. Future conservation efforts should be directed not only to maintaining existing colonies, but to making more sites suitable for nesting terns and perhaps attracting them back to sites where they had previously become extinct. This is particularly pertinent to the Roseate Tern where nest sites on the other side of the Irish Sea have proved more attractive than the once internationally important colonies on Anglesey, where only a handful of breeding pairs remained between 1996 and 2003 and none in 2004. Unfortunately, recent efforts by the RSPB to attract Roseate Terns back to Ynys Feirig and Skerries on Anglesey (provision of nest boxes, establishment of vegetation etc.) are not yet having the desired effect, though other species of tern appear to benefitting. However, Roseate Tern colonies are notably mobile and can shift dramatically over short time spans, so that it is considered worthwhile to maintain suitable conditions in the hope that they will re-colonise former favourite sites in Wales.

Table 17: Summary of trends in population size of seabirds in Wales and Britain between Seabird 2000 (1998-2002) and Operation Seafarer (1969-70) and the SCR Census (1985-88).

	Wales		*Britain*	
Species	*1969-2002*	*1985-2002*	*1969-2002*	*1985-2002*
Fulmar	+	+	+	+/-
Manx Shearwater	?	?	?	?
Storm Petrel	?	?	?	?
Gannet	+	+	+	+
Cormorant	+	+/-	+	+
Shag	+	+/-	+/-	-
Black-headed Gull	-	-	?	?
Lesser Black-backed Gull	+	+/-	+	+
Herring Gull	-	+	-	+/-
Great Black-backed Gull	-	+	+/-	+/-
Kittiwake	+/-	-	+/-	-
Sandwich Tern	+	+/-	+/-	-
Roseate Tern	-	-	-	-
Common Tern	+	+	+/-	-
Arctic Tern	+	+	+/-	-
Little Tern	+	+	+	-
Guillemot[2]	+	+	+	+
Razorbill[2]	+	+	+	+
Black Guillemot[3]	?	+/-	?	+/-
Puffin	+	-	+	+

+ = increase of >10%
- = decrease of > 10%
-/+ = change of < 10%

Seabirds are long-lived, delay breeding until they are several years old, display high rates of annual survival of adults but low rates of post-fledging survival. Breeding population size is most affected by factors that influence adult survival rather than breeding success and post-fledgling survival, unless such effects are sustained over several years. Measuring annual adult survival rates in seabirds is laborious and time-consuming, relying on adult birds to be colour-ringed each year, combined with frequent surveys to identify marked birds in subsequent years. Such measurements in Wales are confined to colonies of several species on Skomer, where researchers from Oxford University and Sheffield University and staff from Wildlife Trust of South and West Wales, are present throughout the breeding season. Their work has shown that species such as Guillemots and Razorbills which have exhibited sustained rises in population size have experienced high levels of adult survival – at least in those years when measurements were taken (Birkhead & Hatchwell 2000, T. Birkhead, unpubl. reports). Conversely, declines in numbers of Lesser Black-backed Gulls, Herring Gulls and Kittiwakes on Skomer have coincided with periods of low levels of adult survival (Brown *et al.* 2004, Perrins & Smith 2000). Reduced adult survival in Lesser Black-backs on Skomer was due to reduction in food supply i.e. the amount of discards produced by French trawlers in the southern Irish Sea, while an outbreak of Botulism on the rubbish tips during the 1970s caused large numbers of adult gulls to die over the course of a few summers.

In addition to reduced food availability and disease, other factors that may cause reduced adult survival include senescence, predation, hunting/culling and stochastic events such as oil spills and severe storms. In the autumn of 1969 over 15,000 seabirds, mostly Guillemots, were washed up dead around the shores of the Irish Sea, killed by starvation thought be compounded by a combination of gales, moulting and perhaps even toxic effects of the heavy metals and organic pollutants found in the tissues of many of the dead birds (Cramp *et al.* 1974). The effect of this event on local breeding populations was unclear, but may have depressed population estimates, particularly of Guillemots, during Operation Seafarer that was conducted at the same time. More recently, the large oil spill that occurred following the *Sea Empress* disaster close to the Pembrokeshire coast in February 1996 (see above) appears to have had little detrimental effect on seabird populations breeding in Wales, despite there being large numbers of auks and Gannets present at colonies at the time of the spill (Colombe *et al.* 1996, Parr *et al.* 1997). There appears to have been no immediate effect on population size or breeding productivity of Cormorants (Sellers & Hughes 1996) or Gannets, even though 4.4% of the Gannets on Grassholm colony showed a degree of oiling some 7 weeks after the spill and many breeding pairs were collecting oil-contaminated nest material (Santillo *et al.* 1998). Hundreds and possibly thousands of adult auks were killed, in addition to immatures (Weir *et al.* 1997) and there were measurable declines in Razorbill and Guillemot numbers at colonies in south Pembrokeshire during the breeding season immediately after the spill (Parr *et al.* 1997, Thompson *et al.* 1997). Numbers of both species appeared to recover at most colonies the following year (Thompson *et al.* 1998), except on St.Margaret's and Caldey Islands, where numbers remained low and in 2004 were still lower than those prior to the spill. The fact that Guillemots and Razorbills attending colonies include non-breeders and sub-adults as well as breeding adults, makes assessing the impact of mortality from events such as oil spills on the breeding population very difficult to measure using colony counts. Given that 5-10% of experienced adult Guillemots present in a population may not breed in any one year (Harris and Wanless 1995) and are probably prevented from doing so due to competition for sites (Kokko *et al.* 2004), it is possible that spaces on ledges vacated by adults killed in the *Sea Empress* spill in 1996 were simply filled by a pool of adult birds waiting to join the breeding population.

Two further oil spills recently occurred in the Bay of Biscay within the non-breeding areas of auks from colonies in Wales and other areas of Britain and Ireland - the *Erika* (Brittany, France, December 1999) and the *Prestige* (Galicia, Spain, November 2002). Both spills killed large numbers of auks, but the majority were immature birds, and indeed there was a much less obvious effect on numbers at Welsh colonies following both spills than occurred after the *Sea Empress* spill (see above). Mortality of adult Guillemots on Skomer decreased during the year of the *Erika* spill; however no measurements of auk survival were conducted on Skomer at the time of the *Sea Empress* spill.

While it is clear that changes in adult survival have contributed to observed changes in population size of some species, productivity, which is monitored at many more colonies for more species in Wales than adult survival, has also been a major determinant of trends in numbers of seabirds breeding in Wales over the last 30 years. Increases in numbers of Razorbills, Guillemots, Sandwich Terns, Common Terns, Arctic Terns and Little Terns

have probably been fuelled by high levels of recruitment following successive years of high productivity, with most of the monitored Welsh colonies of all these species recording the highest levels of fledging rates of any colony in the British Isles, at least since the Seabird Monitoring Programme began in 1986. All these species feed on sandeels and sprats, with the auks able to reach their prey at a variety of depths through pursuit diving, whereas terns rely on their prey being close to the surface. It is thus surprising that productivity of Kittiwakes in Wales has been much lower than the terns during the same period, given that Kittiwakes also feed their young on sandeels and sprats, taken at the surface. Breeding failure of Kittiwakes on Skomer in some years does appear to be caused by birds not being able to provide enough food for their chicks (Brown *et al.* 2004). However, none of these species breeding at Welsh colonies suffered the same catastrophic breeding seasons in 2003 and 2004 that befell colonies in Orkney and Shetland and elsewhere along the North Sea coast where sandeels appear to be in short supply (Mavor *et al.* 2005).

The major decline in breeding numbers of Black-headed Gulls that has occurred in Wales since the early 1970s is difficult to explain, given the lack of any other demographic data. The decline has occurred exclusively at inland colonies (see above) and is a result of a reduction in the number of colonies and constriction of the range of the species, which has also occurred in England during the same period (Dunn 2004). In both Wales and England, agricultural intensification during the 1970s and 1980s, which has had a severe detrimental effect on numbers and distribution of many farmland bird species (Chamberlain *et al.* 2000, Benton *et al.* 2002) may be a likely cause for the decline in inland nesting Black-headed Gulls. Invertebrates form the mainstay of the Black-headed Gull's diet (Cramp and Simmons 1983). Decreases in spring sown cereals has meant a reduction in tillage during the spring and the valuable invertebrate food source this uncovers and a decline in such prey items, through increased pesticide usage may also have occurred (Benton *et al.* 2002). A drop in availability of a high quality food source such as this, prior to the breeding season, coupled with a general decline in insect abundance, may have affected the condition of breeding Black-headed Gulls and may also have reduced productivity.

The drainage of wetland nesting habitat or predation by mammals may have also had an impact on inland nesting Black-headed Gulls. Black-headed Gulls nest in marshes and on islands in inland water bodies that are difficult to access by Foxes, Cats (*Felis domesticus*) or Rats. But both American Mink (*Mustela vison*) and Otters (*Lutra lutra*) are known to depredate eggs, chicks and adults of Black-headed Gulls, although unlike the Mink, Otters do not engage in surplus killing (Craik 1995). Indeed, there are well-documented cases of Mink causing complete breeding failure leading to desertion of entire colonies of Black-headed Gulls and other ground nesting seabirds in W Scotland (e.g. Craik 1995, 1997). Immigration of Black-headed Gulls from areas affected by predation, food depletion and habitat loss may well have contributed, at least in part, to the continued increase of breeding numbers at colonies on saltmarshes along the southeast coast of England. There appears to have been no similar influx into coastal colonies in Wales. Further study is needed into the causes of the dramatic decline of inland nesting Black-headed Gulls, as the demise of this species, once common in Wales and largely ignored by conservationists, becomes an increasing possibility.

REFERENCES

Avery, M.I., Coulthard, N.D., del Nevo, A.J., Leroux, A., Medeiros, F., Merne, O., Monteiro, L. Moralee, A., Ntiamoa-Baidu, Y., O'Briain, M. and Wallace, E. 1995. A recovery plan for Roseate Terns in the East Atlantic: an international programme. *Bird Conservation International* **5**: 441-453.

Birkhead, T.R. & Hatchwell, B. J. 2000. Razorbill. Three Year Report 1997-1999. Contract FC 73-02-92: Developing Methods to Estimate Razorbill *Alca torda* survival on Skomer. University of Sheffield, Sheffield, UK

Brooke, M. de L. 1990. *The Manx Shearwater*. T. and A.D. Poyser, London, UK.

Brown, J.G. & Easton, J. 2000. Seabird monitoring on Skomer Island in 2000. Report to JNCC by The Wildlife Trust, West Wales (formerly Dyfed Wildlife Trust).

Brown, JG and Wilberforce, EM (2003) Seabird monitoring on Skomer Island in 2003. Unpublished report to JNCC by The Wildlife Trust of South and West Wales.

Brown, JG, Perrins, CM, Boyle, D, Duffield, S, Dunstan, A, Easton, J, Smith, S and Parsons, M 2004. Seabird monitoring on Skomer Island in 1999-2002. *JNCC Report No. 339.*

Brown, J.G. and Morgan, L.M. 2004. Seabird monitoring on Skomer Island in 2004. Report to JNCC by The Wildlife Trust of South and West Wales.

Cabot, D. 1996. Performance of the Roseate Tern population breeding in North-West Europe - Ireland, Britain and France, 1960-94. *Proceedings of the Royal Irish Academy* **96**: 55-68.

Cadman, W.A. 1936. Manx Shearwater breeding on Pembrokeshire mainland. *British Birds* **30**: 175.

Camphuysen, C.J., Heubeck, M., Cox, S., Bao, R., Humple, D., Abraham, C. & Sandoval, A. 2002. The Prestige oil spill in Spain. *Atlantic Seabirds* **4**: 127-129.

Colombe, S.V., Reid, J. & Webb, A. 1996. Seabird studies off south-west Wales and south-east Ireland following the *Sea Empress* incident at Milford Haven, February 1996. *JNCC Report* No.225

Condry, W. M. 1981. *The Natural History of Wales*, Collins, London.

Craik, J. C. A. 1995. Effects of North American mink on the breeding success of terns and smaller gulls in west Scotland. *Seabird* **17**:3-11.

Craik, J. C. A. 1997. Long-term effects of North American Mink Mustela vison on seabirds in western Scotland. *Bird Study* **44**:303-309.

Cramp S. & Simmons K.E.L. (eds.). 1983. *The Birds of the Western Palearctic* Vol 3. Oxford University Press, Oxford.

Cramp, S., Bourne, W. R. P. & Saunders, D. 1974. *The Seabirds of Britain and Ireland.* Collins, London.

Donovan, J. & Rees, G. 1995. *Birds of Pembrokeshire.* Dyfed Wildlife Trust. Haverfordwest.

Dunn, T. E. 2004. Black-headed Gull *Larus ridibundus.* In: Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser, London. p. 196-213.

Furness, R.W. 1987. *The Skuas*. T and A.D. Poyser, Calton, England

Gibbons, D. W. & Vaughan, D. 1998. The population size of Manx Shearwater *Puffinus puffinus* on 'The Neck' of Skomer Island: a comparison of methods. *Seabird* **20**: 3-11.

Gibbons, D. W., Reid J. B. and Chapman, R. A. 1993. *The new atlas of breeding birds in Britain & Ireland: 1988-1991.* T. & AD Poyser, London.

Gilbert, G., Gibbons, D. W. & Evans, J. 1998. *Bird monitoring methods, a manual of techniques for key U.K. species.* Royal Society for the Protection of Birds, The Lodge, Sandy, Beds., UK.

Green, J. 2001. Welsh Bird Report 2000. *Welsh Birds* **3(2)**: 75.

Gribble, F. C. 1962. Census of black-headed gull colonies in England and Wales, 1958. *Bird Study* **9**:56-71

Gribble, F. C. 1976. A census of Black-headed Gull colonies. *Bird Study* **23**: 135-45.

Harris, M.P. & Wanless, S. 1995. Survival and non-breeding of adult Common Guillemots *Uria aalge. Ibis* **137**:192-197.

Harris, M.P. 2004. Atlantic Puffin *Fratercula arctica* In: Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser, London. p. 392-406.

Harris, M.P. & Wanless, S. 2004. Common Guillemot *Uria aalge* In: Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser, London. p. 350-363.

Hollom, P. A. D. 1940. Report on the 1938 survey of Black-headed Gull Colonies. *British Birds* **33**: 202 – 21, 230–44.

Hurford, C. & Lansdown, P. 1995. *Birds of Glamorgan.* Hurford & Lansdown, Cardiff.

Jones, P. H. 1974. *Birds of Merioneth.* Cambrian Ornithological Society.

Jones, P. H. & Whalley, P. 2004. *Birds of Anglesey / Adar MIIn.* Menter MIIn, Llangefni.

Kokko, H., Harris, M.P., & Wanless, S. 2004. Competition for breeding sites and site-dependent population regulation in a highly colonial seabird, the common guillemot *Uria aalge. Journal of Animal Ecology* **73**: 367 –376.

Lloyd, C, Tasker, M. L., Partridge, K. 1991. *The status of seabirds in Britain and Ireland.* T & A.D. Poyser, London.

Lovegrove, R., Williams, G. & Williams, I. 1994. *Birds in Wales.* T. & A. D. Poyser, London

Mavor, R.A., Parsons, M., Heubeck, M., Pickerell, G. and Schmitt, S. 2003. *Seabird numbers and breeding success in Britain and Ireland, 2002.* Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, No.27).

Mavor, R.A., Pickerell, G., Heubeck, M., and Thompson, K.R. 2001. *Seabird numbers and breeding success in Britain and Ireland, 2000.* Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, No. 25)

Mavor, R.A., Pickerell, G. Heubeck, M. and Mitchell, P.I. 2002. *Seabird numbers and breeding success in Britain and Ireland, 2001.* Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, No. 26)

Mavor, R.A., Parsons, M., Heubeck, M., and Schmitt, S. 2004. *Seabird numbers and breeding success in Britain and Ireland, 2003.* Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, No. 28)

Mavor, R.A., Parsons, M., Heubeck, M. and Schmitt, S. 2005. *Seabird numbers and breeding success in Britain and Ireland, 2004.* Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, No. 29).

Mitchell, P. I. 2004. Leach's Storm-petrel *Oceanodroma leucorhoa.* In: Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser, London. p. 101-114.

Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser, London.

Monaghan, P. & Coulson, J. C. 1977. The status of large gulls nesting on buildings. *Bird Study* **24**: 89-104

Murray, S. 2000. A count of the Grassholm Gannet colony from aerial photographs taken in 1999. CCW Contract Science Report No. 419. Countryside Council for Wales.

Murray, S. & Walsh, P. 1992. A count of the Grassholm Gannet colony from aerial photographs taken in 1991. Unpubl. Report.

Newton, S. 2004. Roseate Tern *Sterna dougallii.* In Mitchell, P.I., Newtown, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser. London. p.302-314.

Norman, D. 1987. Are Common Terns successful at man-made nesting sites? *Ringing and Migration* **8**: 7-10.

Ntiamoa-Baidu, Y. 1995. Conservation education in threatened species management in Africa. *Bird Conservation International* **5**: 455-462.

Ntiamoa-Baidu, Y., S.K. Nyame, & A.A. Nuoh. 1992. Preliminary report on tern trapping in coastal Ghana. In: For Roseate Tern conservation: *Proceedings of the 1992 Roseate Tern Workshop*, Carantec, France. (ed G. Rolland), pp 47-52. SEPNB, Brest, France.

Parr, S.J., Haycock, R.J. & Smith, M.E. 1997. The impact of the Sea Empress oil spill on birds of the Pembrokeshire coast and islands. 1997 International Oil Spill Conference.

Parsons, M. 2004. Mediterranean Gull *Larus melanocephalus.* In: Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser, London. p. 187-195.

Perrins, C. M. 1997. The shearwaters and storm petrels of the Welsh islands. In: Rhind, P. M., Blackstock, T. H. & Parr, J. (eds.) 1997. Welsh islands: ecology, conservation and land use. Countryside Council for Wales, Bangor, pp. 98-103.

Perrins, C.M. & Smith, S.B. 2000. The breeding Larus gulls on Skomer Island National Nature Reserve, Pembrokeshire. *Atlantic Seabirds* **9**: 195-210.

Pickerell, G. 2004. Little Tern *Sterna albifrons.* In: Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser, London. p. 339-349.

Ratcliffe N. 2004a. Sandwich Tern *Sterna sandvicensis.* In: Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser, London. p. 291-301.

Ratcliffe N. 2004b. Arctic Tern *Sterna paradisaea* In: Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland.* T. & A.D. Poyser, London. p. 328-338.

Ratcliffe, N., Vaughan, D., Whyte, C., & Shepherd, M. 1998a. The development of playback census methods for Storm-petrels *Hydrobates pelagicus. Bird Study* **45**: 302-312.

Ratcliffe, N., Newton S. and Green R.E. 1998b. Survival rates, inter-colony movements and viability of the North West European roseate tern population. *Proceedings of the Colonial Waterbirds Conference.* Florida, 1998.

Ratcliffe, N., Pickerell, G. and Brindley, E. 2000. Population trends of Little and Sandwich Terns *Sterna albifrons and S. sandvicensis* in Britain and Ireland from 1969 to 1998. *Atlantic Seabirds* **2**: 211-226.

Raven, S.J. & Coulson, J.C. 1997. The distribution and abundance of Larus gulls nesting on buildings in Britain and Ireland. *Bird Study* **44**: 13-34.

Santillo, D., ColombO, S., Johnston, P. & Bullock, I. 1998. Oil contamination of gannets and their nests on Grassholm subsequent to the Sea Empress oil spill. Greenpeace/Channel seabirds Research Group/RSPB.

Scott, D. A. 1970. The breeding biology of the storm petrel *Hydrobates pelagicus.* Ph.D. thesis, University of Oxford.

Sellers, R.M. 1994. The 1994 Survey of Cormorant Colonies in Wales. Wildfowl & WetlandsTrust Report.

Sellers, R.M. and Hughes, B.1996. Status and Breeding Success of Cormorants *Phalacrocorax carbo* in Wales in 1996: The Effect of the Sea Empress Oil Spill. CCW Sea Empress Contract Science Report No.231.

Sharrock, J.T.R. 1976. *The Atlas of Breeding Birds in Britain and Ireland.* British Trust for Ornithology, Tring.

Smith, S., Thompson, G., & Perrins, C. M. 2001. A census of the Manx Shearwater *Puffinus puffinus* on Skomer, Skokholm and Middleholm, west Wales. *Bird Study* **48**: 330-340.

Stroud, D. A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clement, P., Lewis, P., McLean, I., Baker, H. & Whitehead, S. 2001. *The UK SPA Network: its scope and content.* JNCC, Peterborough.

Thompson, K. R., Brindley, E. & Heubeck, M. 1997. *Seabird numbers and breeding success in Britain and Ireland, 1996.* Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, No. 21.)

Thompson, K. R., Brindley, E. & Heubeck, M. 1998. *Seabird numbers and breeding success in Britain and Ireland, 1997.* Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, No. 22.)

Vaughan D. 2001. Storm petrel census of Skokholm Island, Pembrokeshire, 2001. A Report to JNCC, Wildlife Trust West Wales.

Vaughan, D. & Gibbons, D. 1996. Storm petrels on Skokholm Island, 1995. A Report to CCW, RSPB & Dyfed Wildlife Trust

Walsh, P. M., Halley, D. J., Harris, M. P., del Nevo, A., Sim, I. M. W. & Tasker, M. L. 1995. *Seabird monitoring handbook for Britain and Ireland.* JNCC / RSPB / ITE / Seabird Group, Peterborough.

Wanless, S., Murray, S., Harris, M.P. and Evans, S. 2005a. A count of the Grassholm gannetry in 2004. CCW Contract Science Report no. 604

Wanless, S., Murray, S., Harris, M.P. 2005b. In press. The status of Northern Gannet in Britain and Ireland in 2003/04. *British Birds* **98**.

Weir, D., Kitchener, A., McGowan, R., Kinder, A. & Zonfrillo, B. 1997. Origins, population structure, pathology and diet of samples of diver and auk casualties of the *Sea Empress* oil spill. Final Report by the National Museums of Scotland and University of Edinburgh to the Sea Empress Environmental Evaluation Committee. CCW *Sea Empress* Contract Report, no. FC73-02-69.

ACKNOWLEDGEMENTS

The author would like to acknowledge and thank all those who took part in Seabird 2000 in Wales, with particular thanks to those who co-ordinated counts in their region: David Rees, Sian Whitehead, Hywel Roderick, Steve Sutcliffe and Derek Thomas; and to the Seabird 2000 partners in Wales: Countryside Council for Wales and RSPB. Data on tern populations was supplied by RSPB. Data on productivity and adult survival and population monitoring was obtained from the Seabird Monitoring Programme database administered by JNCC, Aberdeen (see www.jncc.gov.uk/marine/seabirds). Hywel Roderick, Steve Sutcliffe and Graham Williams provided useful information and comments on an earlier draft.

APPENDIX I: Summary of prescribed counting periods and units.

Species	Time of year	Time of day (BST)	Count Unit
Fulmar	15 May – 5 July	0900 – 1730	AOS
Manx Shearwater	late May – early June	Day light	AOS
Storm Petrel	July	Day light	AOS
Cormorant	1 May – 25 June	Day light	AON
Shag	15 May – 25 June	Day light	AON
Gulls (*Larus spp.)*	15 May – 5 June	(recommended 0900 – 1600 for flush counts of individuals)	AON
Kittiwake	26 May – 25 June	Day light	AON
Terns	15 May – 5 July	(recommended 0800-1600 or preferably 1000-1200 for flush counts of individuals)	AON
Guillemot & Razorbill	1 – 21 June	0800 - 1600	Individuals on suitable breeding ledges
Black Guillemot	26 March – 15 May	0500 - 0900	Individuals on sea and/or land
Puffin	25 April – 5 June	Day light	AOB

AON = Apparently occupied nest; AOS = Apparently occupied site, AOB = Apparently occupied burrows.

DENSITIES OF BREEDING SKYLARKS *Alauda arvensis* IN UPLAND WALES

— MICK GREEN —
Bronhaul, Pentrebach, Talybont, Ceredigion SY24 5EH

SUMMARY

Numbers of Skylarks breeding on four sites in upland Wales were recorded during general bird surveys. Densities found were much higher than other recent records and emphasise the importance of the Welsh uplands for this declining species.

METHODS

Four sample sites were surveyed totalling 10 km^2. Sites were chosen at random in that they were being surveyed for other purposes. The counts were made in the course of censusing waders using Brown & Shepherd's (1993) method. The sites were visited twice during the breeding season, once between mid April and mid May and once between mid May and mid June. For Skylark, singing males were recorded onto maps and each singing bird was taken as representing a breeding pair.

Table 1. Sites surveyed

Site	Location	Altitudinal range	Habitat
A	Nr Ammanford, Carms.	270 – 340m	Grazed sheepwalk, large areas of *Nardus* with some recovering but low growing heath and wetter areas dominated by *Molinia*
B	Elenydd, Powys	450 – 508m	Grazed sheepwalk, mainly *Nardus* and wetter areas dominated by *Molinia*
C	Nr Staylittle, Powys	450 – 480m	Grazed sheepwalk comprising patchwork of *Nardus*, *Molinia* and small areas of heavily grazed heath.
D	Berwyn, Powys/ Denbigh	680 – 820m	Upland ridge, mainly lightly grazed but low growing *Nardus* and areas of thicker heather.

RESULTS

The results are given in Table 2

Table 2. Density of Skylarks (Pairs/sq.km.)

Site,	Year surveyed.	Size (Km^2)	Density (Pairs/km^2)
A	2004	4	14.0
B	2002	3	14.3
C	2004	1	19.0
D	2004	2	4.5

DISCUSSION

The national Skylark survey of 1997 (Browne *et al* 2000) gave mean densities of 2.09 pairs per km^2 for the whole of Wales across all habitats. Across the UK as a whole, arable land held the highest densities at 4.55 pairs per km^2 with marginal upland the second highest density at 3.6 pairs per km^2. Mean densities worked out from BBS results for Wales over 1994 – 2002 (BTO 2004) give a figure of 3.5 pairs per km^2.

Previous surveys have also shown high densities in the Welsh uplands, but with much variation. Lovegrove *et al* (1994) noted that surveys in 1988 on Pumlumon, on similar habitat to sites covered in this study, had densities of up to 20 pairs per km^2 while on Mynydd Eppynt densities of only 3.5 pairs per km^2 were recorded in 1988-90 (although densities of up to 15 pairs per km^2 have since been noted, with variation probably due to differing levels of military disturbance [M. Shrubb *pers.com.*]). From the figures in this study it is clear that some upland sites hold much higher than average densities and they have not all experienced the declines noted elsewhere.

Browne *et al* (2000) gave a mean population estimate for Wales of 45,263 (52,193 maximum) pairs using squares chosen to sample all habitat types. Given the high densities recorded in this study, and the obvious high variability of densities noted in this and other studies, it may be that this figure is an underestimate.

Browne *et al* (2000) also noted that upland habitats remain under-studied relative to lowland arable areas. The Welsh uplands undoubtedly hold important numbers of Skylark. Changes in management are likely to occur in the future from agri-environment prescriptions, CAP payment changes and developments such as windfarms or biomass planting. The implications of these changes to Skylark populations are not clear and further work is needed before widespread changes occur – especially those associated with agri-environment prescriptions.

REFERENCES

Brown, A. F. and Shepherd, K.B. 1993. A method for censusing upland breeding waders. *Bird Study* **40**: 189 - 195

Browne, S., Vickery, J., and Chamberlain, D. 2000. Densities and population estimates of breeding skylark *Alauda arvensis* in Britain in 1997. *Bird Study* **47**: 52-65

BTO 2004 Breeding Bird Survey Results. www.bto.org/bbs

Lovegrove, R., Williams, G., and Williams, I. 1994. *Birds in Wales*. T. & A.D. Poyser, London

PEREGRINE *Falco peregrinus* PREDATION OF WOODCOCKS *Scolopax rusticola*: EVIDENCE OF NOCTURNAL HUNTING

— ANDREW DIXON AND COLIN RICHARDS —

South Wales Peregrine Monitoring Group,
C/o 96 Yr Ysfa, Maesteg, Bridgend. CF34 9BE

SUMMARY

Woodcocks were only found in the prey remains at Peregrine breeding sites from October to May and the timing and frequency of these kills reflected the known pattern of winter migration into and out of Wales. A peak in the frequency of Woodcock remains at these sites in November suggests that the first wave of immigrants includes a significant proportion of passage birds moving through Wales to more southern wintering grounds. The occurrence of Woodcock in the diet provides indirect evidence that Peregrines can hunt successfully after sunset as well as during daylight in the winter period. The potential impact of raptor predation on the relatively scarce Woodcock breeding population in Wales is discussed.

INTRODUCTION

Woodcocks, despite being active mainly at night, often fall prey to Peregrines (*Falco peregrinus*). Ratcliffe (1993) reported that Woodcocks (*Scolopax rusticola*) were found in over 70% of Peregrine prey lists in North Wales, northern England, southern Scotland and the Highlands and surmised that these may partly be birds that follow open moorland during migration and those 'roding' over open hillsides. In southern Scotland, Woodcocks comprised nearly 4% of prey items at Peregrine territories in winter (Mearns, 1982), whilst in Northumberland they made up 6% of prey remains by frequency and 13% by weight during winter (Dixon, in press). In our own study in south-central Wales, Woodcocks comprised nearly 8% of prey remains found in the winter period from October to March (Dixon *et al.*, 2003).

In Wales, Woodcocks are distributed widely but sparsely during the breeding season, with a distinct bias towards eastern districts (Gibbons *et al.*, 1993), though the species is probably under-recorded in many areas. They breed in woods and forests in both lowland and upland areas, particularly in the early and late growth stages of forestry plantations. Breeding residents are mostly sedentary, though a few move south into France and Iberia (McKelvie, 1996). In winter, migrant Woodcocks, mainly from breeding populations in Scandinavia, the Baltic States and Russia (Wernham *et al.*, 2002) arrive in Wales in such large numbers that they are probably the most abundant and widespread wader over most inland regions of the Principality at this time of year. Average winter shooting bags of Woodcock in Wales are higher than in most regions of Britain (Tapper & Hirons, 1983), confirming that large numbers of migrant Woodcock winter in Wales. Once settled in their wintering areas, Woodcock spend the daylight hours resting in ground cover within woods, forests and on moorland and hillsides, only becoming active at night when they fly to their feeding grounds, especially grass pastures, to forage for invertebrates. Woodcocks arrive in two main waves during autumn passage in the latter part of October and in larger numbers during November (Vesey-Fitzgerald, 1959; McKelvie, 1996), but the return passage is more gradual and takes place during March and to a lesser extent in April (Lovegrove *et al.*, 1994).

METHODS

Over a 20-year period from 1985-2004 we collected and identified prey remains found at Peregrine breeding sites in south and central Wales throughout the year. Prey remains were found at breeding sites within the vice counties of Breconshire, Cardiganshire, Carmarthenshire, Glamorgan, Monmouthshire and Radnorshire. Searches were made around the nesting area with particular emphasis placed on the inspection of buttresses and prominences where Peregrines tend to pluck their prey. At some extensive breeding ranges where Peregrines occupied widely dispersed nesting sites it was not always possible to search all of the alternative sites during a visit.

We have only included site visits where we found prey remains that we considered to have been recently killed, judging by the quantity and condition of the feather remains. The number of prey searches conducted during each month varied, as did the number of Peregrine sites visited. To account for this we have calculated the percentage of sites at which Woodcock remains were found during each month.

RESULTS

We found a total of 32 recent Woodcock remains (2.1 % of prey remains, $N = 1541$), all of which were found between October and May. During this period we found recent prey remains in 406 visits to 74 different breeding sites, compared to 219 visits to 59 sites between June and September, when no fresh Woodcock remains were found. During the eight month period from October to May, 24 breeding sites were only visited during one month, 17 during two, 12 during three, 12 during four, 2 during five, 2 during six, 2 during seven and 3 during all eight months.

Table 1. The number of different Peregrine breeding sites visited, the number of visits made to these sites, the number of recent prey remains found and the percentage (number) that were Woodcock remains during each month from October to May

	N Sites	N Visits	N Prey Remains	% Woodcock (N)
October	20	39	86	1.2 (1)
November	15	33	63	7.9 (5)
December	27	44	122	2.5 (3)
January	13	27	51	9.8 (5)
February	25	50	95	6.3 (6)
March	26	65	131	5.3 (7)
April	45	88	228	0.9 (2)
May	33	60	145	2.1 (3)

Woodcocks were most commonly found during prey searches at breeding sites from November through to March and to a lesser extent in October, April and May (Table 1).

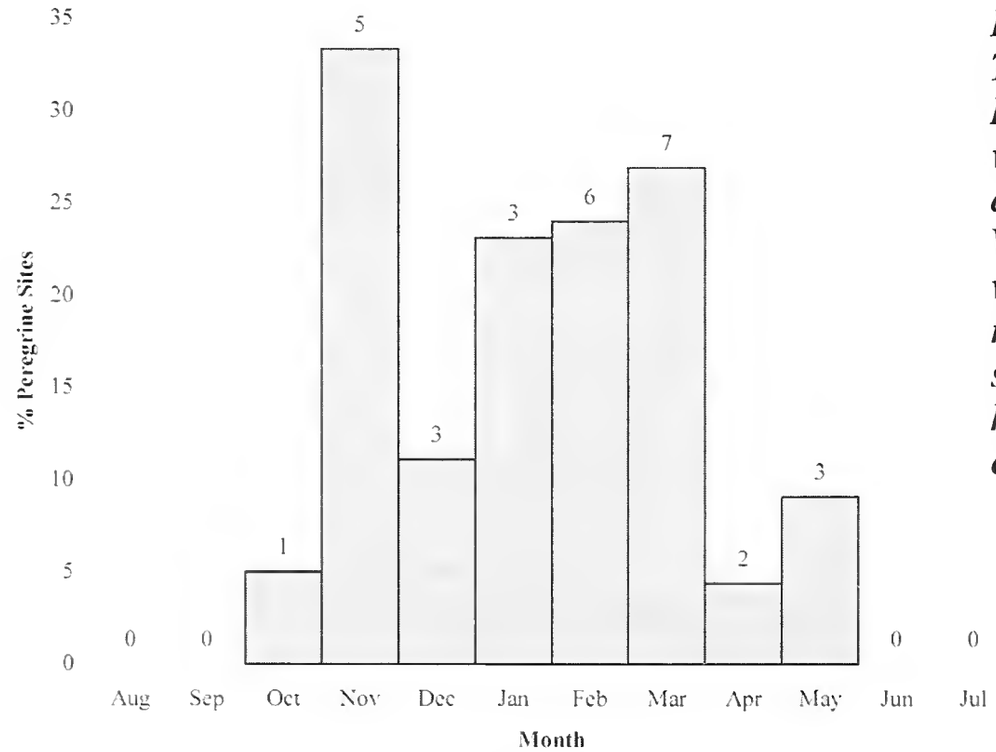


Figure 1.
The percentage of Peregrine sites visited each month at which recent Woodcocks remains were found. The number of Peregrine sites is given at the head of each column.

Included within the recent prey remains was a ring, which was found in a fresh pellet and came from a Woodcock that was ringed in the Nord region of France on the 20th October 2002 (age and sex not recorded).

Recent Woodcock remains were found at 18 of the 74 breeding sites visited during October to May. The proportion of Peregrine sites at which recent Woodcock remains were found was highest in November but much lower in December, followed by a gradual increase during the months from January to March (Figure 1). Six of the 74 breeding sites visited were coastal sites but no Woodcocks were found during ten visits to these sites when a total of 25 recent prey remains were found. The 18 inland sites where Woodcock prey remains were found were widely distributed across south-central Wales and most had substantial areas of forestry plantation or deciduous woodland within a 500 m radius of the nesting site. The number of Woodcocks found at different territories ranged from 1 to 5, but this frequency was related primarily to the number of times each site was visited, therefore we were not able to detect if Woodcocks were more likely to be killed at some sites than at others.

DISCUSSION

Woodcocks are susceptible to predation by Peregrines whilst on passage, which takes place at night, or when flying to and from their night-time feeding grounds. Studies in Cornwall, where there were numerous pastures as in south-central Wales, revealed that Woodcock flew 125 m to 1290 m (mean 514 m) from their daytime cover to their nocturnal feeding grounds (Hirons & Bickford-Smith, 1983). These flights took place between 29-42 minutes after sunset and 32-57 minutes before sunrise depending on cloud conditions (Hirons & Bickford-Smith, 1983). Woodcock may also be susceptible to predation by Peregrines after being flushed during daylight hours, for example by dog-walkers or beaters at organised shoots. However, it seems very unlikely to us that the Woodcocks found during this study were killed during daylight hours and it is evident that Peregrines must also hunt after sunset, particularly during the winter. During the breeding season, from March to June, Woodcocks tend to be more active at dusk and dawn than they are during the winter, particularly the males, which engage in 'roding' flights after sunset and before sunrise. A proportion of the Woodcocks killed from March to May might have been taken during dusk and dawn roding flights rather than at night.

Occasional night-time hunting was recorded by some breeding pairs of Peregrines in an Australian study (Olsen *et al.*, 1998), indicating that nocturnal hunting is not necessarily confined to the winter period. A study of non-breeding Peregrines in Florence also detected evidence of nocturnal hunting, with Woodcock and two species of bats recorded in the prey remains (Serra *et al.*, 2001). Direct evidence of nocturnal hunting is difficult to observe, particularly outside the nesting period, but we suspect that the behaviour might actually be quite common, particularly in winter when daylight hours are short. At this time of year it usually very dark before Woodcocks fly from their roost sites and it seems remarkable that a Peregrine, being a visual predator can pick out and successfully catch a Woodcock in the darkness of a winter night in the Welsh hillsides.

The monthly variation in proportion of Peregrine sites at which Woodcock remains were found at fits neatly with the known timing of their migration into and out of Wales, with the main influx occurring during November and most wintering birds having left by April. The pattern exhibited suggests the main wave of immigrants into Wales arrive during November. This November peak clearly suggests that the early wave of immigrants includes a significant proportion of passage birds that move onwards to more southerly wintering areas, presumably in south-west England or in France and Iberia. Woodcocks usually arrive in Scotland during the second week of October with the first birds reaching southern England and Ireland about 10 days later and the influx of migrants into Britain continues until late December (Wernham *et al.*, 2002). The ring we recovered probably came from a wintering or passage bird as the French breeding population is thought to be mainly sedentary (Cramp & Simmons, 1982). It was killed in October 2003 and, as Woodcock tend to be faithful to their wintering haunts (Wilson, 1983), its migration route into Wales the previous autumn took it through the northern tip of France.

It is likely that most Woodcocks killed from October to March were immigrant, wintering birds, when migrant Woodcocks outnumber residents in Britain by about 13 to 1 (Wernham *et al.*, 2002). Woodcocks commence breeding in the latter half of March and a proportion of those killed in April and May were probably resident breeding birds. Breeding males on conspicuous roding flights must be particularly susceptible to predation, though it is possible that some wintering males may also engage in roding flights prior to departure from Wales. Peregrines, Goshawks and Sparrowhawks are widespread in Wales, whilst the latter is a common species the former two are by no means rare. Sparrowhawks and Goshawks often share the same breeding haunts as Woodcocks in Welsh forestry plantations and studies of both species in this habitat indicate that Woodcocks comprise about 1% of prey items found during April to August (Sparrowhawk; Newton, 1986) and March to September (Goshawk; Toyne, 1998). It is conceivable that predation by birds of prey might limit the number of Woodcock breeding in Wales, or at least diminish the population of roding males. Detailed studies of breeding Woodcock in Derbyshire and Sweden revealed that there was a surplus of non-roding males in the population that could replace any roding birds lost to predation, in which case it is unlikely that raptor predation has any significant impact (Marcstrom, 1974; Hirons, 1983). However, it is not known if such a surplus exists in Wales where the breeding population is much smaller than in Derbyshire and Sweden, and where even a low frequency of predation could potentially remove a significant proportion of the small breeding cohort.

ACKNOWLEDGEMENTS

We would like to thank Graham Hirons for his comments that greatly improved an earlier version of this paper. We were regularly helped during fieldwork by Paul Haffield, Mark Lawrence, Alan Lowe, Glyn Roberts and Mike Thomas. Visits to Peregrine sites during the active nesting period were carried out under licences issued to AD and CR by the Countryside Council for Wales.

REFERENCES

Cramp, S. and Simmons, K.E.L. (eds.). 1982. *The Birds of the Western Palearctic,* Vol. III.

Dixon, A. (In Press) The diet of Peregrines at breeding territories in Northumberland. *Transactions of the Natural History Society of Northumbria* 64.

Dixon, A., Richards, C., Lawrence, A., and Thomas, M. 2003. Peregrine (*Falco peregrinus*) predation on racing pigeons (*Columba livia*) in Wales. In *Birds of Prey in a Changing Environment* eds. D.B.A.Thompson, S.M.Redpath, A.H.Fielding, M. Marquiss and C.A.Galbraith. The Stationery Office, Edinburgh.

Hirons, G. 1983. A five-year study of the breeding behaviour and biology of the Woodcock in England – A first report. *Proceedings of the Second European Woodcock and Snipe Workshop*. IWRB, Slimbridge pp. 51-67.

Lovegrove, R., Williams, G. and Williams, I. 1994 *Birds in Wales*. T & AD Poyser, London.

Marcstrom, V. 1974 On the courtship flight of the Woodcock (*Scolopax rusticola*) in Sweden. *5th American Woodcock Workshop Proceedings*. Athens, Georgia.

McKelvie, C. 1996. *Snipe and Woodcock: sport and conservation.* Swan Hill Press, Shrewsbury

Mearns, R. 1982. Winter occupation of breeding territories and winter diet of Peregrines in South Scotland. *Ornis Scandinavica* **13**: 79-83.

Newton, I. 1986. *The Sparrowhawk*. T & AD Poyser, Calton.

Olsen, P., Doyle, V., and Boulet, M. 1998. Variation in male provisioning in relation to brood size of Peregrine Falcons *Falco peregrinus*. *Emu* **98**: 297-304.

Ratcliffe, D.A. 1993. *The Peregrine Falcon (Second Edition)*, T & AD Poyser, London.

Serra, G., Lucentini, M., and Romano, S. 2001. Diet and prey selection of nonbreeding Peregrine Falcons in an urban habitat of Italy. *Journal of Raptor Research* **35**: 61-64.

Tapper, S., and Hirons, G.. 1983. Recent trends in Woodcock bags in Britain. *Proceedings of the Second European Woodcock and Snipe Workshop*. IWRB, Slimbridge pp. 132-137.

Toyne, E.P. 1998. Breeding season diet of the Goshawk *Accipiter gentilis* in Wales. *Ibis* **140**: 569-579.

Vesey-Fitzgerald, B. 1959. *British Game*. Collins, London.

Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M., and Baillie, S.R.(eds.) 2002. *The Migration Atlas: movements of the birds of Britain and Ireland.* T. & A.D. Poyser, London.

Wilson, J. 1983. Wintering site fidelity of Woodcock in Ireland. *Proceedings of the Second European Woodcock and Snipe Workshop*. IWRB, Slimbridge pp. 18-27.

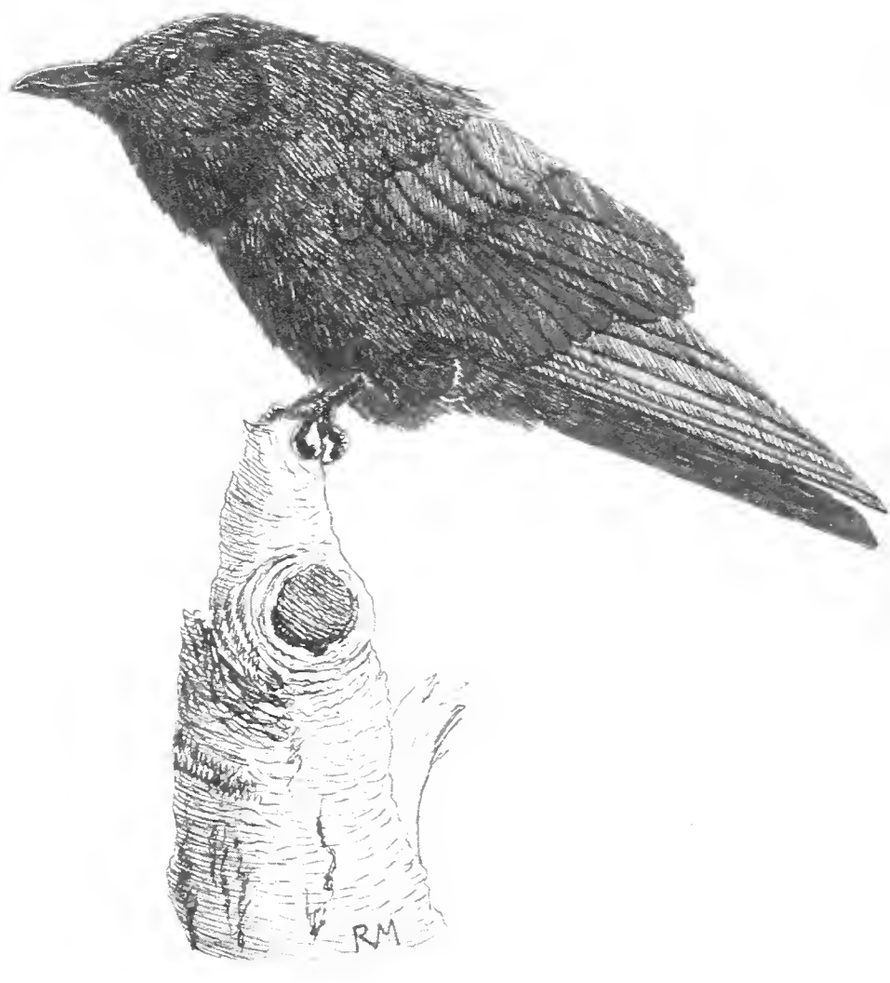
A STUDY OF BREEDING CARRION CROWS *Corvus corone* IN SNOWDONIA

— JULIAN DRIVER —

Hafod y Fedwen, Gwyllt Road, Llanfairfechan, Conwy LL33 0EG

SUMMARY

This paper summarises the results of a six-year study (1987 to 1992) of breeding Carrion Crows on the northern slopes of the Carneddau mountain range in Snowdonia. The study area was divided into four altitudinal zones ranging from sea-level to 942m and covered 47 km^2. The most populated zone was the upland sheep pastures between 150m and 350m with a mean density of 7.52 nests per sq. km (maximum 15 pairs per sq. km) and an average nest spacing of 332m. Carrion Crows were also found nesting in close groups with nests spaced at 50m to 200m and there was good evidence of synchronous egg laying within these groups. Breeding densities above and below this zone were considerably lower. The average first egg date was April 14th and the mean clutch size was 3.59 eggs. However, there was evidence of later egg laying, reduced clutch sizes, and lower success rates for nests with increasing altitudes. Of all recorded nesting attempts 48% were successful and these produced an average of 2.20 fledged youngsters. An average of 1.06 youngsters were fledged from all attempted nests. Many causes for nest failure were recorded though the most vulnerable period was around hatching time. Predation of broods by Buzzard , Raven and Tawny Owl was noted but interference of nests by man was insignificant.



INTRODUCTION

During 1987 I began recording the contents of Carrion Crow *Corvus corone* nests for the BTO nest record scheme and this eventually progressed into a more definite study of this species in my home area of North Wales. This study covered a period of six years up to 1992 during which time I censused the breeding population and recorded detailed breeding data.

STUDY AREA AND HABITATS

The study area covers a 47 km^2 section of the northern slope of the Carneddau mountains overlooking the North Wales coastline and is in the old county of Caernarvonshire. It incorporates all land lying within the watershed of three mountain streams that flow down into Conwy Bay at Abergwyngregyn and Llanfairfechan. The highest point is Foel-fras at 942m (3,091ft) from where the area covered descends the steep mountain slopes to lower sheep pastures and woods, and eventually to the sandy shores of Traeth Lafan.

The area comprises roughly four zones that are determined by altitude and land use. The lowest zone (sea level to 50m) is a narrow coastal plain, which is made up of arable and grazed pasture with many tall trees and spinneys plus the village of Abergwyngregyn and town of Llanfairfechan. Above this zone at 50m to 150m there is a steep escarpment with extensive Sessile Oak woodland, which is intersected by a deep wooded valley to the west and a more open valley to the east. The slopes above this zone (150m to 350m) are gentler and comprised of enclosed upland sheep pasture with many scattered Hawthorns and hedgerow Oaks. Above 350m this grades into open mountain sheep-walk where Mat Grass (*Nardus*) and Heather (*Calluna*) predominate with occasional scattered Rowan and Sallow trees by mountain streams and on small crags.

The climate of the study area is strongly influenced by its proximity to the Irish Sea and lies within the hyperoceanic subsector as described by Bendelow and Hartnup (1980) with high precipitation, warm winters and long cool summers. This climatic zone only covers the western extremes of NW and SW Wales.

POPULATION, DISTRIBUTION AND DENSITY

Carrion Crows were found nesting throughout the area and at all altitudes from sea level up to 650m (2,133 ft). I recorded a total of 160 breeding territories within the boundaries of the study area plus another 30 pairs for which I was unable to locate nest sites and which may have been non-breeders.

The density of nesting pairs varied greatly between the different altitudinal zones and land use types. The most nests and maximum nesting density were found on the upland sheep pasture between 150m and 350m where there was, on average, 7.52 occupied nests per sq km (Table 1). The highest density within one particular square km of upland sheep pasture with many scattered trees was 15 occupied nests. In contrast, the mountain grassland zone above 350m was the least populated with only 0.46 nests per sq km even though this composed just over half [51%] of the study area (Table 1).

Table 1. Density of regular nesting pairs in different altitudinal zones

Altitudinal Range (metres)	Land type	Total land area km^2 and (%)	Total number & (%) of nests	Mean number of nests per km^2
0 - 50	Agricultural coastal plain	4.70 (10)	20 (13.0)	4.26
50 - 150	Steep wooded hillsides	4.23 (9)	17 (11.0)	4.02
150 - 350	Enclosed upland sheep pasture	14.10 (30)	106 (68.8)	7.52
350 - 942	Rough mountain grasslands	23 .97 (51)	11 (7.1)	0.46

Mean nest density in the coastal zone was 4.26 nests per sq km. However, it should be noted that this habitat only covered a relatively small proportion (10%) of the study area and includes less favourable urban areas which held very few breeding pairs. In the Oak woodlands, on steep hillsides above the coastal zones, breeding Carrion Crows were relatively few and mostly confined to the upper and lower woodland fringes adjacent to grazed pasture.

Using data from two seasons, 1989 & 1992, the average distance between occupied nests on the upland sheep pastures was 332m. There was a strong tendency for pairs to nest in loose groups and I identified six such groupings within my study area with nests spaced, between 50m and 200m apart.

From observations at one of these sites, with occupied nests spaced at 100m, there were indications that a bigamous male was attending both nests but it was not possible to prove this. On several occasions I also observed additional third birds in the immediate vicinity of occupied nests. Such occurrences were also noted by Coombs (1978) who considered these 'third birds' to be non-breeding males which are sufficiently persistent and aggressive to become temporarily tolerated by the resident pair.

NEST SITES

The majority of nests were in isolated trees or within small groups of trees on open ground and very few nests were within dense woodland. The lowest nesting pair used a Tamarisk (*Tamarix sp.*) bush growing at the Spring High Tide Zone by Traeth Lafan and the highest nest was on a small crag at 650m (2,133 ft.) below the summit of Foel-fras. Unusually, three pairs nested on electricity pylons and single pairs on a telegraph pole, on a small mountain crag, and in an old Raven (*Corvus corax)* nest in an Ash tree. There was also one nest in a Rock Whitebeam (*Sorbus rupicola)* growing out of a rock face and another nesting on a thick Ivy (*Hedera helix*)covered cliff. In addition I also discovered the remains of what appeared to be an old Carrion Crow nest on top of an exposed dry stonewall by a derelict farm house on Moelfre at 400m.

Eighteen species of trees were used (Table 2) of which Sessile Oak (*Quercus petraea)* was the most frequently chosen (29%). Deciduous trees were the most frequently used (96%) and only (4%) of nest sites were in conifers. In the more sheltered lowlands most trees attain their maximum heights and consequently nest heights were much higher with an average of 10m to 12 m. In contrast, on the exposed uplands many Oak and Hawthorn trees have stunted growth and have average heights of less than 5m. Many nests in these localities were in isolated, wind stunted Hawthorns and only 2- 3m off the ground. Their dense thorn cover provided excellent protection against ground predators such as Foxes or more serious avian threats such as Buzzards (*Buteo buteo),* Ravens or other Carrion Crows. Regular breeding pairs used alternative nest sites during most years though there were a few instances where nests were used repeatedly for two or three years. This was especially the case at higher altitudes where in some regions there might be only one suitable nest tree within a territory. One pair used the same nest successively throughout the six study years in an isolated Sallow bush by a mountain stream.

Table 2. A list of tree species used by nesting Carrion Crows and the total number and (%) used during the six-year study period, 1987 to 1992

	Totals	(%)
Oak (*Quercus petraea*)	101	29.0
Hawthorn (*Crataegus monogyna*)	86	24.5
Ash (*Fraxinus excelsior*)	47	13.5
Sycamore (*Acer pseudoplatanus*)	24	7.0
Crab Apple (*Malus sylvestris*)	19	5.5
Rowan (*Sorbus aucuparia*)	16	4.5
Alder (*Alnus glutinosa*)	15	4.5
Sallow (*Salix caprea*)	12	3.5
Scots Pine (*Pinus sylvestris*)	12	3.5
Silver Birch (*Betula pendula*)	6	2.0
Holly (*Ilex aquifolium*)	3	1.0
Larch (*Larix sp.*)	2	0.5

LAYING DATES

Peak egg laying occurred between April 12th and 20th, with a mean first egg date of April 14th. The earliest nest had a first egg date of March 31st and the latest was May 20th. There was only one instance of a pair laying a repeat clutch, in an alternative nest following the destruction of the original nest during a gale. First-egg dates were established for 15 regular nesting pairs during successive seasons and the mean variation of first egg date for each pair was only 1.9 days. Some pairs layed consistently early whilst others were consistently late layers.

There was also strong evidence of synchronous laying of eggs within the different groups of closely spaced nesting pairs. For example, in 1992 one group (A) of 5 pairs, with a mean nest spacing of 282m, all laid first eggs between April 16th and 18th, whereas another group (B) of 7 pairs that were 2.5 kms away, laid first eggs between April 12th and 14th (4 of these pairs laid first eggs on the same day, April 13th).

There was evidence of a progressive altitudinal effect on egg laying (Table 3) with laying starting later in nests at higher elevations, though the sample of nests above 350m was small. The earliest egg laying occurred in nests below 150m with a median first egg date between April 13th to 15th , whilst those nests between 150m to 350m had a median first egg date of April 16th to 18th.

Table 3. First-egg dates in relation to nest altitude

Altitude (m)	*No of nests*	*Average first egg dates*
0 - 150	61	April 13th to 15th
150 - 350	207	April 16th to 18th
> 350	17	April 22nd to 24th

The data show that clutches laid above 350m were started about 9 days later than those laid below 150m. The very latest first-egg date of May 20th was recorded for a nest at 475m.

CLUTCH SIZE

Over the six years the mean complete clutch size in 324 nests was 3.59 eggs and an annual variation between 3.18 and 3.77 eggs. (Table 4). Carrion Crows laid from 2-6 eggs but mostly 3-4 eggs. In addition, there were 16 nests, which held single eggs and where no more eggs were laid. It is assumed that other eggs had been laid but had been predated or disappeared prior to my visits. All these single-egg nests were incubated at least during the early stages but only four of them successfully fledged single youngsters. At the other extreme, clutches of 6 eggs were very unusual.

Table 4. Completed clutch sizes in 324 nests of Carrion Crows: annual variations

Year	Clutch sizes						No of nests	Total eggs	Average clutch size
	0ne	two	three	four	five	six			
1992	1	8	14	35	16	0	74	279	3.77
1991	3	3	13	29	6	2	56	206	3.68
1990	3	7	12	22	4	0	48	155	3.23
1989	4	12	18	32	9	0	75	255	3.40
1988	4	5	11	16	2	0	38	121	3.18
1987	1	6	7	17	1	0	32	107	3.34
nests	16	41	75	151	38	2	323	1123	3.48
%	5.0	12.7	23.2	46.7	11.8	0.6			

There were three instances where additional single eggs had been laid about one week after the completion of the clutch and these have been included for clutch sizes in table 4. A slight reduction in mean clutch size of 0.60 (15.5%) egg was found with increasing altitude (Table 5).

Table 5. Mean clutch size in relation to altitude

Altitude (m)	*No of nests*	*Mean clutch size*
0-150	53	3.86
150-350	165	3.80
>350	16	3.26

BROOD SIZES

The earliest newly-hatched chick was recorded from a nest on April 19th and the latest was on the 1st June. The main hatching period was between May 1st and 10th and the average brood size in 250 nests, with chicks at least one week old, was 2.73 chicks (Table 6). There was a difference of 0.89 (30%) chick between the best/worst years of 1991/92.

BREEDING SUCCESS AND TOTAL PRODUCTIVITY

The average size of successful broods varied between years from 1.71 to 2.62 young, and this was in successive years (1990,1991).

Table 6. Brood sizes in nests with chicks aged more than one week old: annual variations

Year	Brood Sizes						Number of Broods	Total chicks	Average brood sizes
	One	Two	Three	Four	Five				
1992	6	19	16	15	2		58	162	2.79
1991	6	6	17	16	0		45	133	2.96
1990	2	11	10	7	0		30	82	2.07
1989	16	13	19	11	1		60	148	2.47
1988	5	8	12	6	2		33	91	2.76
1987	3	8	6	6	1		24	66	2.62
Nests	38	65	80	61	6		250	682	2.73
%	15.2	26.0	32.0	24.4	2.4				

Table 7. Number of fledged youngsters produced by successful pairs of Carrion Crows: annual variations

Year	number of fledged young						Number of Nests	Total young	Average fledged
	One	Two	Three	Four					
1992	13	13	11	5			42	92	2.19
1991	5	5	19	3			32	84	2.62
1990	9	9	3	0			21	36	1.71
1989	9	10	9	1			29	60	2.07
1988	4	11	5	2			22	49	2.23
1987	3	4	3	1			11	24	2.18
Nests	43	52	50	12			157	345	2.20
%	27.4	33.1	31.8	7.6					

An average of only 1.06 chicks was fledged from all nests, including both successful and failed nests. during the six-year study period. Successful pairs reared an average of 2.20 fledged youngsters with most rearing either 2 or 3; very few reared 4 young (Table 7). This was because many nests failed completely. For the complete set of 324 nests, only 48% produced fledglings. There were annual differences in success rate ranging between 35-57% (Table 8)

Table 8. Variations in the annual success rate of 324 nests

Year	1987	1988	1989	1990	1991	1992	Totals
Total nests	32	38	75	48	56	75	324
Number of successful nests	11	22	29	21	32	42	157
% successful	34.6	57.9	38.7	43.7	57.1	56.0	48.5

For these 324 nests, which contained a total of 1107 eggs, 682 eggs (60.7%) hatched and produced chicks that survived for more than one week. Of these nests, 345 eggs (31.2%) of those laid, or 50.6% of those hatched, produced fledged youngsters.

CAUSES OF NEST FAILURES

Failure at the egg stage occurred for a variety of reasons but persecution of nests by man was insignificant, just 7 instances where nest contents were deliberately destroyed. During the three years 1990 to 1992 I recorded in detail the fate of 559 eggs in 164 nests; causes of loss are summarized in Table 9.

Table 9. Fate of eggs in 164 nests (1990 to 1992)

a) Losses during incubation	No. of eggs (%)	No. of nests
Clutch deserted	21 (3.5)	8
Clutch failed to hatch or addled	46 (7.7)	36
Eggs disappeared	15 (2.5)	7
Clutch destroyed during gales	15 (2.5)	5
Eggs damaged	1 (0.2)	1
Clutch destroyed by man	10 (1.7)	3
Totals	108 (18.0)	81
b) Eggs failed at or around hatching	139 (23.2)	81
c) Eggs hatched but chicks died in nest		
Small chicks – naked or in pin	64 (10.7)	44
Large chicks – partially or fully feathered	74 (12.4)	50
Totals	138 (23.0)	94
d) Eggs producing fledged young	214 (35.7)	91

Overall, there was a loss of 18% of eggs before hatching and 23% at around hatching time. Among chicks more than a week old there was an overall mortality rate of 23% and in the end, only 36% of eggs produced fledged young (Table 9).

In 1992 five nests were damaged by severe gales and the contents destroyed. At one particularly exposed moorland nest a large half-grown chick was blown out of a damaged nest but survived to fledge on the ground hidden amongst dense Bracken (*Pteridium aquilinum*) below the nest.

The causes of chick mortality were often unknown though I did find evidence of broods being predated by Buzzard, Raven and Tawny Owl (*Strix aluco).* On two occasions I watched Buzzards flying from Carrion Crow nests and carrying young chicks and I once found the remains of a freshly taken one-week old crow chick in a Buzzard nest. I also found three freshly taken crow chicks aged about one and a half weeks in an occupied Tawny Owl nest box. It appeared that they had been taken from a crow nest about 20m away. More recently, and in another part of North Wales, I witnessed a Raven taking a large feathered crow chick from a nest in a tall Ash tree whilst being mobbed heavily by the parent birds.

DISCUSSION

The overall distribution and densities of nest sites throughout my study area suggested that the availability of permanently grazed sheep pasture was an important factor for nesting Carrion Crows. The greatest density of nests occurred on the upland sheep pastures where there is also a wide scattering of suitable nest trees. These permanent grasslands are rarely ploughed and receive very little agricultural improvement apart from an occasional application of lime. Consequently they have a good stable invertebrate fauna on which Carrion Crows can forage throughout the year. Six closely spaced nesting groups were found exclusively within this zone. In contrast there was a lower density of nests along the coastal plain even though there was an equal or greater availability of suitable nest trees. It is considered that the temporary nature of these lowland pastures, which are rotated with arable crops or used for silage production, do not provide the same year-round foraging opportunities found on permanent pasture. Winter shooting of corvids within this zone was infrequent and focused mainly on flock birds, and was not considered to be a threat to the local breeding population.

The low density of nests found on the mountain sheep walk is considered to reflect the more severe climatic conditions, a scarcity of suitable nest trees, and impoverished grasslands with poor food potential. Inevitably, breeding success was reduced in this high altitude zone compared to lower down, with only 36.7% of nests succeeding and producing a mean of 1.25 fledged youngsters.

An overall mean laying date of April 14th for all nests within my study area corresponded very closely to a mean date of April 13th established during a previous study of Welsh nesting Carrion Crows (Holyoak 1967) but this study was only of nests below 150m (500 ft asl). Holyoak also found that Carrion Crows laid much earlier in Wales than in other areas of England and Scotland where the mean laying date varied between April 18th to 27th. Synchronous laying of eggs which occurred within groups of nesting crows in my study area was also noted during a study of Carrion Crows in NE Scotland by Yom-Tov (1975). He suggested that this might help reduce interference and destruction of nest contents by non-breeders and thus increase the chances of success.

There was good evidence of an altitudinal effect on egg laying within my study area and similar results were noted by Holyoak (1967) when analysing BTO nest record cards for Carrion Crow nests in N. England & S. Scotland. However, his average first egg dates were about 9 days later than for Carneddau birds in corresponding altitudinal zones. The earlier egg laying within my study area could be a consequence of the milder climatic conditions in this part of Wales. The mean clutch size of 4 eggs for Carrion Crows in Wales below 150m given by Holyoak (1967) is slightly larger than that (3.86 eggs) within my study area at comparable altitudes.

Variations in annual breeding performance were recorded and this was particularly noticeable during 1990 and 1991 which produced the smallest and largest clutch and fledged brood sizes respectively. 1990 also had the highest nest failure rate when 56.3% failed completely. It is possible this variation may have been the result of climatic conditions. Following on from a very mild winter the spring and summer of 1990 were particularly dry with almost drought conditions and the hard ground may have caused

difficult feeding conditions for breeding Carrion Crows. The following winter (1990/91) saw more typical weather and was followed by a prolonged cool wet spring through to early summer when conditions were probably more favourable for ground feeding birds such as Carrion Crows. The effects of food availability on the breeding performance of nesting crows was also noted by Yom-Tov (1974).

The causes for nest failures, particularly during the brood stage, were often difficult to assess though it is thought that Buzzards were a major threat to broods. There were several Buzzard territories within the study area and interaction between these two species was a frequent occurrence. In addition to those observations mentioned previously, I also found many nests where large chicks had recently disappeared and where the wool lining had been pulled upwards in the centre suggesting that the chicks had been plucked out of the nest and had grasped the wool lining. Unidentified feathers of young corvids were also often found in local Buzzard nests. On the other hand it is known that Carrion Crows occasionally take Buzzard eggs and such occurrences were recorded during a Buzzard study on Dartmoor (Dare 1961).

Another major threat to Carrion Crow nests contents comes from their own species and though I never found evidence of this during my study, predation of eggs and chicks by non-breeding crows was considered by Yom Tov (1975) and Charles (1972) to be a most important factor.

ACKNOWLEDGEMENTS

I am particularly indebted to Dr. Peter Dare for editing a draft copy of this paper and making numerous helpful suggestions for improving the content . Thanks also to Mike Shrubb for taking the time to read through an earlier version and for his many constructive comments.

REFERENCES

Bendelow, V. C. & Hartnup, R. 1980. *Climatic Classification of England and Wales.* Harpenden.

Charles, J. K. 1972. *Territorial behaviour and limitation of population size in the Crows (Corvus corone and Corvus cornix)* Ph D Thesis. Aberdeen University.

Coombs, C. J. F. 1978. *The Crows – A study of the Corvids of Europe.* B.T. Batsford Ltd., London.

Cramp, S. & Perrins, C. M. (eds). 1994. *The Birds of the Western Palearctic* Vol. VIII. Oxford University Press.

Dare, P. J. 1961. *Ecological Observations on a Breeding Population of the Common Buzzard, with special reference to the diet and feeding habits.* Ph D Thesis, Exeter University.

Holyoak, D. 1967. Breeding biology of the *Corvidae.Bird Study* **14**: 153-68.

Yom-Tov, Y. 1974. The effect of food and predation on breeding density and success, clutch size and laying date of the Crows (*Corvus corone. Linn.*). *Journal of Animal Ecology* **43**: 479-98.

Yom-Tov, Y. 1975. Synchronisation of breeding and intraspecific interferences in the Carrion Crow. *Auk* **92:** 778-85.

MEASURING THE DIET AND PREY ABUNDANCE OF CHOUGHS *Pyrrhocorax pyrrhocorax* IN NORTH WALES

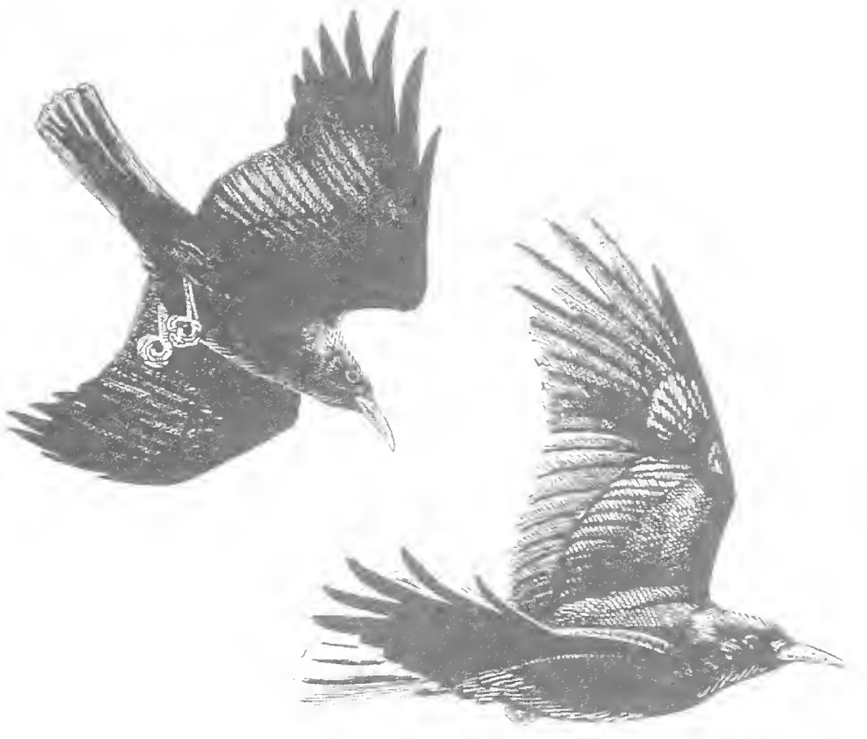
— SIAN WHITEHEAD & IAN JOHNSTONE —*

RSPB North Wales Office, Maes y Ffynnon, Penrhosgarnedd, Bangor LL57 2DW, UK

**Present address: Countryside Council for Wales, Maes y Ffynnon, Penrhosgarnedd, Bangor LL57 2DW, UK.*

SUMMARY

1. The abundance and accessibility of preferred foods is likely to be one of several critical factors determining the best foraging sites for choughs. The aim of this study was to measure the diet of choughs across sites that reflect their range in north Wales, to complement a concurrent study of the physical characteristics and selection of different habitats.



2. Faeces were collected from coastal and inland breeding and wintering sites, and prey fragments identified. Attempts to measure prey populations in some of these places proved unsatisfactory due to inadequate levels of precision.

3. Over 140 faecal samples were collected from seven sites, two age-classes (adults and dependent young) and two seasons (breeding and winter). Analyses suggested diet richness was measured more completely and occurrence in diet with greater precision for larger samples. So, although total sample size fell within the range used by other studies, interpretation of these data is limited by small samples within some groups of interest.

4. During breeding when adults are tied to nest sites, both soil-living prey (e.g. larval crane flies) and surface-active prey (e.g. adult beetles) featured strongly in diets. In winter, when birds move more freely, prey restricted to rare foraging habitats such as dune slacks was present, suggesting some foraging specialism at this time. There was also a difference in diet between two adjacent breeding pairs, which could be explained in part by an apparent difference in prey distribution.

5. Data on chough diet in north Wales remain incomplete. Larger sample sizes for the groups of interest would allow age-specific, spatial and seasonal patterns to be determined more accurately. Explaining foraging site preferences in terms of the abundance of prey preferred at that time, in addition to the physical characteristics of that site remains a challenge.

INTRODUCTION

Despite generally increasing in Wales in recent decades (Thorpe & Johnstone 2003), the Chough is amber-listed at both Welsh (Thorpe & Young 2002) and UK and Isle of Man levels (Gregory *et al* 2002) because of its moderately declining status in Europe overall (BirdLife International 2004). In addition, its' potential sensitivity to changes in livestock farming means the Chough has been identified as a Species of Principle Biodiversity Importance (Welsh Assembly Government 2003).

Choughs are predominantly invertebrate feeders (Roberts 1982; McCracken & Foster 1993; Sanchez-Alonso *et al* 1996, Meyer *et al* 1994). Because of this, the accessibility and abundance of key invertebrate foods are critical factors determining where Choughs can forage successfully, and the presence of livestock appears important in providing these conditions (Bignal *et al* 1996). Choughs feed by probing in soil, gleaning from the soil surface and vegetation, and searching herbivore dung using their short curved bills. Previous published and unpublished studies in northwest Europe suggest specific invertebrates often feature in diets at different times of year, at times supplemented by cereal grains from harvested fields and whole crop animal feeds (Table 1), with seasonal availability identified as the most important factor for inclusion in diet (Bullock 1980, McCracken *et al* 1992).

Table 1. Previous studies of chough diet in northwest Europe. Data were collected in different places and at different times of year and were based on different sample sizes.

Site	Diet	Season	Method & sample size	Reference
Anglesey	Moth larvae and tipulids	Breeding season (April-June)	Faecal samples from foraging birds	Bullock (1980)
	Ants, beetles & spiders	Post fledging (July-Sept)	(n≈1000)	
	Beetles & their larvae	Winter (Oct-Feb)		
Bardsey	Beetles & tipulids	Spring & Autumn	Faecal samples	Roberts (1982)
	Ants	Summer	(n=328)	
	Kelp flies & sandhoppers	Late Autumn		
NW Islay	Tipulids	Jan-July	Faecal samples from	McCracken *et al* (1992)
	Bibionids	Jan-April	roosts and pulli	
	Dung associated insects	Spring, late summer & autumn	(n=60)	
	Surface active insects	Summer		
	Cereals	October-April		
Pembrokeshire	Ants	Breeding season	Pellet & faecal	Meyer *et al* (1994)
	Beetles & tipulids	All year	samples plus direct	
	Dung fauna	Winter	observation	
	Grain & earthworms	"Lean periods"	(n=335)	

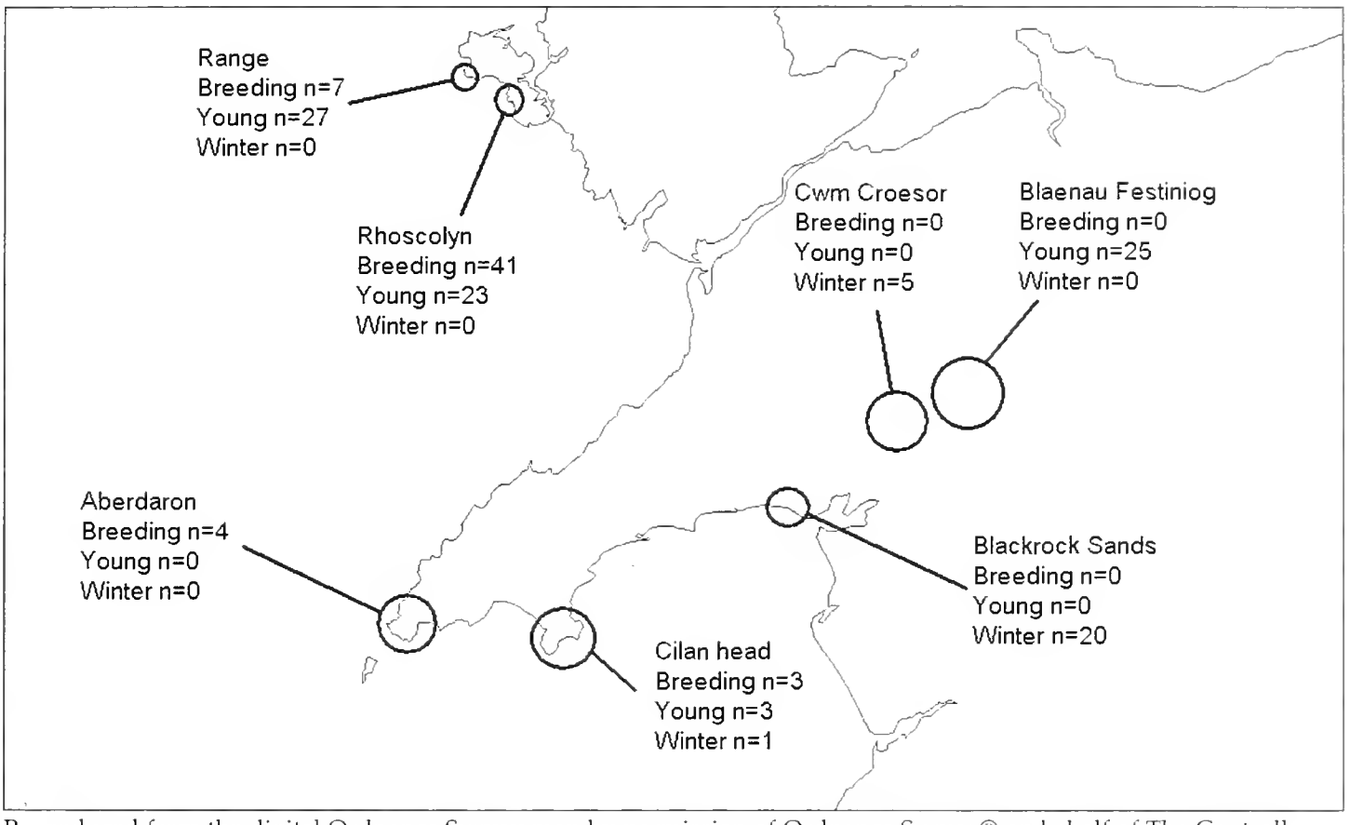
An animals' diet is a measure of the types and amounts of food eaten (Stephens 1996). Studies of diet and foraging behaviour, including habitat selection, can help answer questions about conservation management (Sutherland *et al* 2004). For example, what are the consequences of habitat and management change? Diet often varies through the year and between sites, age groups and even individuals, so the sampling methods used in studies of diet need to reflect this variability (Sutherland *et al* 2004). In all such studies therefore, methods used need to be evaluated so a) diet richness (the range of foods taken) is fully measured and b) food occurrence (percentage of samples containing each food type) is measured with sufficient precision.

The aim of this study was to measure the diet of the Chough across sites that reflect their coastal and inland range in north Wales for different life stages and at different times of year.

METHODS

Diet

Faeces were collected from adult Choughs, pulli and recently fledged juveniles, and from a range of breeding and non-breeding sites in North Wales (Fig.1). Most faeces were collected during the breeding season (April to July), while in winter (October and November) samples were from sites frequented by flocks at this time.



Reproduced from the digital Ordnance Survey map by permission of Ordnance Survey® on behalf of The Controller of Her Majesty's Stationary Office. All rights reserved. ©Crown Copyright. RSPB Licence AL100026659.

Figure 1. Locations of the sites in North Wales used for measuring Chough diet at different times of year, and sample sizes for different age groups and seasons. Three additional samples from pulli were collected from nests on Anglesey

Faeces from adults and juveniles were collected opportunistically when individuals were seen to defecate, during concurrent detailed foraging observations (Whitehead *et al* in press). Most samples from pulli were collected during visits to ring them under licence, but some additional samples were collected from near the nest as faecal sacs, after being dropped by parent birds removing them from the nest. The faeces were placed in plastic tubes as soon as possible after defecation, labelled with the date, time and pair identity, and stored frozen. Choughs sometimes regurgitate pellets of indigestible matter (e.g. Meyer *et al* 1994). However, none were seen being produced during the present study.

To analyse, faeces were diluted in tap water, and examined under an x25 binocular microscope. Fragments were identified with the aid of reference samples stored in 40% alcohol, following previous studies (e.g. Green and Tyler 1989, Moreby 1988). Identification was to the lowest taxonomic level possible. For some, it was only possible to attribute them to Order, but for others, such as Diptera and Coleoptera, it was sometimes possible to identify Family or occasionally Genus.

Representation of prey within samples

Representation of prey items within the faeces is dependent on their digestibility. For Choughs, some fragments of digested prey were much easier to identify than others. Counting and measuring these as measures of the relative abundance and size distribution of prey taken was therefore deemed unreliable because of bias towards those prey with the most robust and distinctive remains (for example, leatherjacket mandibles). Therefore, only presence or absence of each prey type within each faeces was used in analyses.

The influence of faecal sample size on the diet recorded

Diet richness is a measure of the number of different prey types recorded in the diet. For a given diet composition, this was expected to increase asymptotically with the number of faeces samples examined. This can be used to estimate the point at which diet richness is measured adequately well, and the level of caution that should be associated with results based on smaller samples. The occurrence of each prey type in the diet is the percentage of samples with each type present. As the number of faecal samples examined increases, precision was expected to increase (confidence limits become smaller).

A sub-sample of faeces results was selected at random with replacement from the available sample, and diet richness measured to Order level. This was then repeated 99 times, and the mean and 95% confidence limits calculated for each sub-sample of 100. This was carried out for two main groups of samples: breeding adults (n=55) and dependent young (n=61). Sub-samples were n=5, 10, 20, 30, 40 and 50. This exercise was also carried out for the percentage occurrence of a common prey type (tipulid larvae).

RESULTS

The influence of faecal sample size on the diet recorded

For both adult breeding birds and dependent young, diet richness doubled between n=5 and n=50 (Fig.2). For adults and juveniles, diet richness was an asymptotic function of

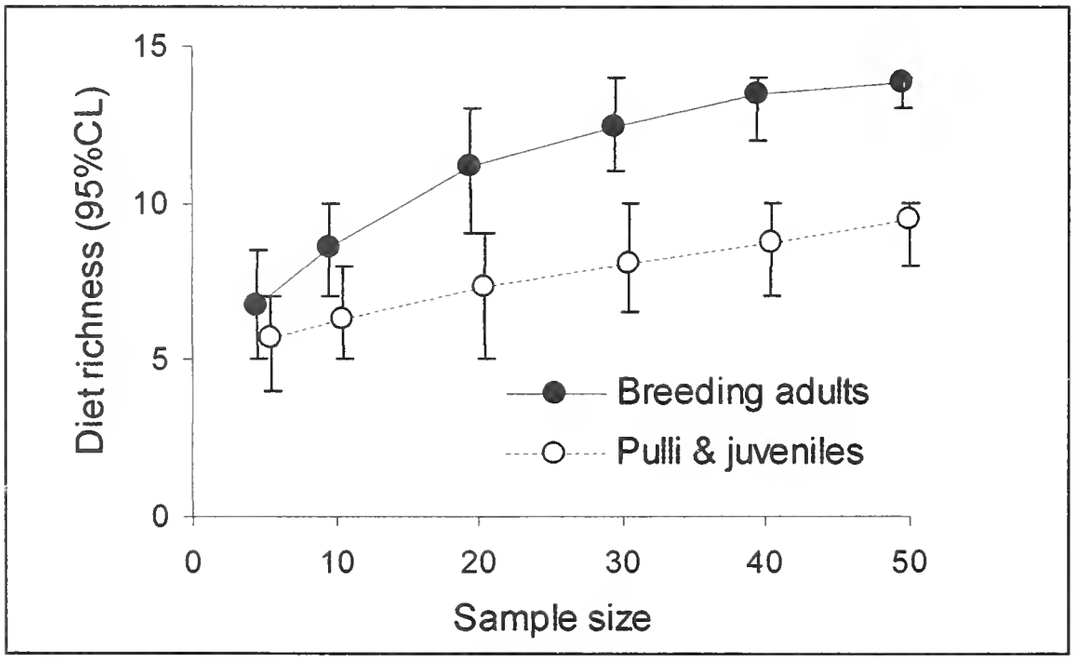


Figure 2. Change in the diet richness of Choughs (based on prey identification to Order) in relation to the number of faeces samples used. Means and confidence limits were calculated using a re-sampling procedure (see text).

sample size, with a less than 10% increase in the number of prey types between n=30 and n=50. However, for pulli, the function was linear over the range of sample sizes examined, indicating that new prey types were appearing in the diet at the same rate. The available sample size for wintering birds was too low for a similar analysis to be informative.

The precision with which the occurrence of tipulid larvae was recorded in faecal samples increased with sample size (Fig.3). For both breeding adults and dependent young the SE was less than 10% of the mean when sample size exceeded 10.

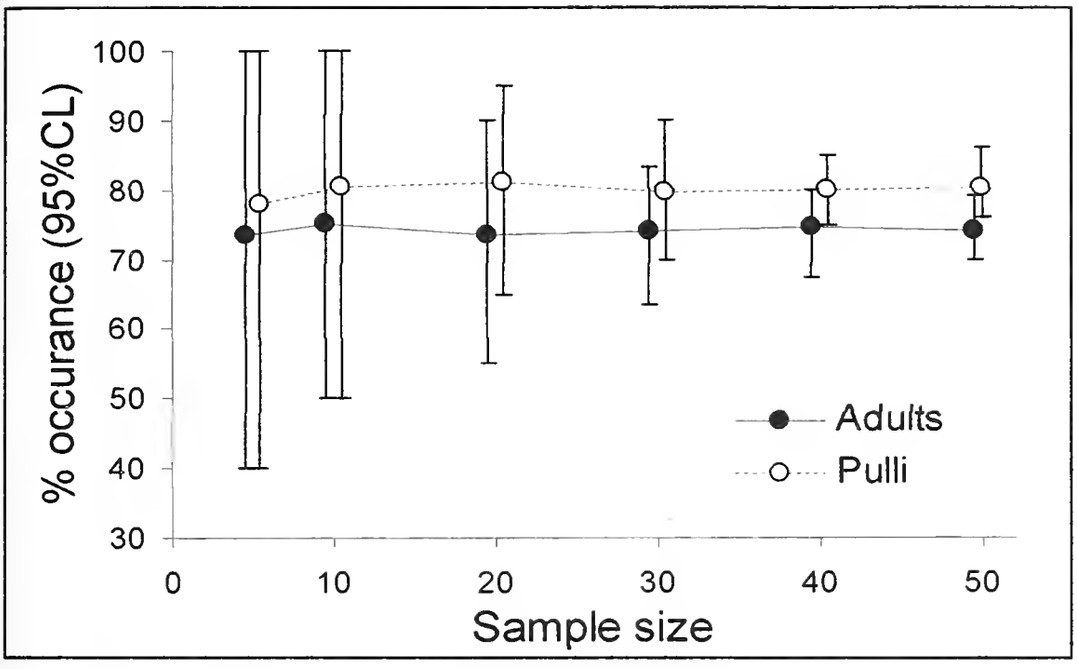


Figure 3. The effect of increasing sample size on the precision with which the occurrence in the diet of tipulid larvae was measured for breeding adult and dependent young Choughs.

Means and confidence limits were calculated using a re-sampling procedure (see text).

Diet richness

The number of prey types in the diet varied between groups, with coastal breeding adults having the most varied diet, wintering birds the least varied, and dependent young intermediate (Table 2). However, because samples sizes also varied, these differences in diet richness cannot necessarily be attributed to differences in foraging ecology.

The occurrence of prey types in diet

The opportunistic nature of faeces collection resulted in low or zero sample sizes for some groups. For example, no faeces at all were collected from breeding birds at the inland site because most observations took place over considerable distances. Sample size influenced both diet richness and the precision with which occurrence was measured. However, although occurrence was less sensitive to small sample sizes than richness, the small and disparate sample sizes limit interpretation, and preclude statistical analyses.

A summary of results is given in Table 2, which shows, for each type of prey item encountered, their percentage occurrence in faecal samples. For example, 50% occurrence means an item was encountered in half of the faeces analysed. Data are

Table 2. The percentage occurrence of prey items in Chough faecal samples from coastal and inland sites. Sample size refers to the number of faeces rather than the number of birds sampled. Each of these is further divided into breeding and wintering, and adults and pulli. Ad and larv denote adult and larval stages. Percentage occurrence within in taxonomic sub-groups is shown in italics. These data are pooled for the higher taxonomic groups given, for which diet richness was calculated (% prey types present).

Diet composition	% Occurrence in faecal samples					
	All samples	Coastal			Inland	
		Breeding		Wintering	Breeding	Wintering
		Adult (n=62)	Pullus (n=29)	Adult (n=21)	Pullus (n=25)	Adult (n=5)
Lumbricidi	7.0	11.3	10.3	0	0	
Mollusca	1.4	0	0	4.8	4.0	0
Aranidae	55.6	45.2	72.4	14.3	92.0	80.0
Acari	6.3	11.3	0	0	4.0	20.0
Amphipoda	13.4	0	0	90.5	0	0
Chilopoda	0.7	0	0	4.8	0	0
Collembola	1.4	3.2	0	0	0	0
Dermaptera	4.9	4.8	0	19.0	0	0
Hemiptera	1.4	3.2	0	0	0	0
Lepidoptera(larv)	25.4	19.4	65.5	4.8	16.0	0
Diptera (ad)	1.4	3.2	0	0	0	0
Diptera (larv)	21.1	87.1	86.2	9.5	80.0	80.0
Tipulidae	*64.1*	*74.2*	*86.2*	*0*	*80.0*	*0*
Symphyta (larv)	1.4	1.6	3.4	0	0	0
Formicidae	36.6	40.3	51.7	0	44.0	20.0
Coleoptera (ad)	83.8	80.6	100	95.2	100	100
Carabidae	*18.3*	*14.5*	*31.0*	*9.5*	*24.0*	*0*
Staphylinidae	*9.2*	*8.1*	*20.7*	*0*	*8.0*	*0*
Trogidae	*0.7*	*1.6*	*0*	*0*	*0*	*0*
Geotrupidae	*14.8*	*3.2*	*3.4*	*9.5*	*60.0*	*20.0*
Scrabaeidae	*26.1*	*11.3*	*27.6*	*0*	*0*	*100*
Elateridae	*33.1*	*37.1*	*34.5*	*0*	*56.0*	*0*
Tenebrionidae	*9.9*	*3.2*	*31.0*	*14.3*	*0*	*0*
Endomychidae	*7.0*	*8.1*	*13.8*	*4.8*	*0*	*0*
Circulionidae	*0.7*	*0*	*3.4*	*0*	*0*	*0*
Coleoptera(larv)	4.2	27.4	62.1	19.0	72.0	80.0
Carabidae	*6.3*	*0*	*3.4*	*0*	*32.0*	*80.0*
Staphylinidae	*1.4*	*1.6*	*3.4*	*0*	*0*	*0*
Scarabaeidae	*5.6*	*0*	*0*	*19.0*	*0*	*0*
Elateridae	*33.8*	*22.6*	*62.1*	*0*	*64.0*	*0*
Tenebrionidae	*0.7*	*1.6*	*0*	*0*	*0*	*0*
Cereal grain	0.7	1.6	0	0	0	0
Diet richness	100	72	56	38	38	22

further divided among coastal, inland, breeding and non-breeding categories. For breeding season samples, these are further broken down into faeces from adults and dependent young. Overall, adult Coleoptera were most frequently present in the diet, while Diptera larvae occurred in more than half the faeces analysed, predominantly represented by tipulids. Other larvae, particularly of beetles, were also frequently represented. Spiders and ants comprised most other prey items.

Coastal vs inland-breeding adults

Comparing between groups, few samples contained Lumbricidi, and these were all from coastal birds. A higher proportion of inland than coastal samples contained spiders, whilst the diet of the coastal birds sampled contained a higher proportion of lepidoptera larvae. Similar proportions of samples from both coastal and inland birds contained tipulids and ants. Although some adult beetles, such as tenebrionids, only occurred in coastal samples, adult beetles on the whole were present more often among inland samples, although represented here by different taxonomic groups (geotrupids and scarabids). The high frequency of beetle occurrence at inland sites was also reflected in the numbers of samples containing beetle larvae, although these were mostly of carabids and elaterids.

Breeding vs wintering

Comparisons between breeding and wintering are limited by two factors. First, the small sample sizes for the wintering group, and second, because faeces were collected from different habitats: most of the coastal winter samples coming from dune slacks rather than the semi-improved pasture and coastal heath of the breeding season samples. Winter samples were characterised by the high frequency of occurrence of amphipods, and these were from birds that had been feeding in the dune slacks at

Table 3. The percentage occurrence of prey items in Chough faecal samples from two neigbouring breeding pairs at one coastal site. Clearly, sample size refers to the number of faeces rather than the number of birds sampled. Ad and larv denote adult and larval stages. Percentage occurrence within in taxonomic sub-groups is shown in italics. These data are pooled for the higher taxonomic groups given, for which diet richness is calculated (% prey types present).

Diet composition	Pair A (n=15)	Pair B (n=25)
Lumbricidi	0	18.2
Aranidae	6.7	54.5
Acari	53.3	4.5
Collembola	33.3	4.5
Dermaptera	20	4.5
Hemiptera	6.7	9.1
Lepidoptera (larv)	0	27.3
Diptera (ad)	93.3	0
Diptera (larv)	13.3	95.4
Tipulidae	*26.7*	*86.4*
Symphyta (larv)	100	0
Formicidae	0	40.9
Coleoptera (ad)	80	90.9
Carabidae	*6.7*	*13.7*
Staphylinidae	*6.7*	*13.6*
Trogidae	*0*	*4.5*
Scarabaeidae	*13.3*	*9.1*
Elateridae	*46.7*	*36.4*
Tenebrionidae	*0*	*4.5*
Endomychidae	*6.7*	*13.6*
Coleoptera (larv)	80	40.9
Elateridae	*26.7*	*40.1*
Tenebrionidae	*0*	*4.5*
Cereal grain	0	4.5
Diet richness	58	79

Blackrock sands. As might be expected, there were fewer winter samples with surface-active invertebrates such as spiders and adult beetles, although there was still some evidence of adult chafers and dung beetles. Chafer larvae were the only beetle larvae represented in the winter samples.

Adults vs dependent young
Comparing data from adults during breeding with pulli showed that most prey types were more frequent in the latter. This difference was particularly noticeable for spiders, lepidoptera larvae, and both adult and larval beetles. Proportions of diptera larvae (of which tipulids dominated) were similar in both adult and pulli samples.

Differences between adjacent pairs
Comparing between two adjacent coastal breeding pairs for which the biggest sample sizes were collected showed a difference in diet composition (Table 3). The lack of pattern in these differences may reflect differences in prey abundance and availability between their foraging-ranges, which did not overlap, or a difference in foraging preferences between these pairs.

Prey abundance
Biomass density varied considerably both within and between samples of soil-cores. Furthermore, not all samples contained prey. Overall, 96% of 36 samples contained soil arthropods (although earthworms were abundant, they only featured in diet occasionally and because of this were excluded from any analyses). Averaging within then across samples, the mean biomass density was 8.48g per core (SE=5.05 n=5 & 36). As rule of thumb, the SE should represent approximately 10% of the value of the mean for reasonable precision and statistical power to be achieved (i.e. ability to detect any differences that are present). In this case, the value was 80% overall (data were first ln(x+1) transformed to approximate a normal distribution) Furthermore, the mean of the samples sizes required to achieve the desired level of precision was 395, which was considered impractical.

DISCUSSION

Sample sizes
In this study, 142 faecal samples were analysed, and this falls within the range of sample sizes used by previous studies in northwest Europe (Table 1). Therefore, whilst there is evidence that these data for north Wales underestimate diet richness, this limitation is unlikely to be restricted to the present study. The diet richness of coastal breeding adults was asymptotic based on the main prey types, with few additional main prey types being recorded as sample size exceeded 30. In contrast, diet richness of dependent young was non-asymptotic over this range of sample sizes. New prey types were recorded at the same rate as sample size increased. This could be because the diet fed to young changed through the rearing period or varied between coastal and inland. Among groups therefore, only the diet of breeding adults was measured completely. Sample size for other groups suggests some prey types may have been missed.

Occurrence in the diet was measured with adequate precision when sample size exceeded 10 for the prey-type evaluated, and was similar for both breeding adults and dependent young. This suggests that comparisons of occurrence between groups with samples sizes equal or greater than this should be meaningful.

Chough diet

The findings of this study reflect those of other diet studies of Chough in northwest Europe (Table 1), illustrating the high occurrence in the diet of adult and larval beetles, tipulid larvae and other soil and surface invertebrates accessible using the Chough's short curved bill. Despite the acknowledged data limitations resulting from small sample sizes, this study does illustrate the importance of certain taxonomic groups in the Choughs' diet. Furthermore, this evidence shows that Chough in north Wales feed on both soil-living and surface-active invertebrates, and this will have implications for attempts to relate preferences for foraging locations to prey abundance. However, attempts to do this by measuring prey abundance using soil-cores and pitfall trapping proved unsatisfactory due to inadequate precision. Acceptable levels of precision would have required unfeasibly large sample sizes. Nevertheless, these diet data also support previous studies that have highlighted the species' flexibility to feed opportunistically on food that is at times both abundant and accessible.

Observed differences between sites and seasons may simply be an artefact of small sample sizes and lack of statistical independence, with relatively few pairs and nests contributing much of the data. However, it is likely that some differences are attributable, at least in part, to real differences in prey abundance and accessibility between habitats and seasons, or to the foraging specialisms of particular individuals. Thus, the presence of ants in the diet of one coastal pair, but not their neighbour is most likely explained by the presence of anthills in only the territory of the former, in which these prey are easy to find, although the latter diet was based on a smaller sample size.

Other patterns include the presence of amphipods in the diet of wintering birds that were foraging in coastal dune slacks away from breeding sites. Such prey are only present on or near beaches, and that they were only recorded from faeces in these places suggests gut transit times were relatively rapid, supporting the feeding trials of Bullock (1980) (1.5-2hrs) and Meyer (1991) (<6hrs), and suggests that diet from faeces might be biased towards the most recently used foraging habitats for some prey types. Alternatively, the diet evidence may reflect the exclusive use of these places by some birds during this period. This specialism in diet is a good reflection of how choughs find and exploit localised food supplies over seasonal and shorter time-scales. This adaptability in diet choice was observed by Roberts (1982), but the extent to which this comes about solely through sampling the environment or is influenced by information transfer between mixed generations in flocks that forage and roost together (e.g. Wright *et al* 2003) is unclear.

The low occurrence of earthworms in the diet may have been an artefact of small sample sizes, or low detectability in faeces (see Meyer 1991). However, they may represent low quality prey (Meyer 1990). The almost complete absence of earthworms from the diet of birds in this study may be a reflection of favourable feeding conditions that provide an adequate biomass of high quality prey.

Conclusions

This study has confirmed our previous understanding of Chough diet, although evidence suggests diet richness was incompletely measured for some groups. Therefore, data on the diet of Choughs in North Wales remain incomplete. Larger sample sizes, particularly

for inland breeding birds and wintering birds would allow age-specific, spatial and seasonal patterns to be determined more accurately. Habitat selection by Chough in Wales and elsewhere in northwest Europe is now well understood (Whitehead *et al* in press). However, the selection of foraging patches was not fully explained by their physical characteristics, suggesting other factors, such as prey abundance, played a role. Explaining preferences for foraging locations in terms of diet selection and intake rates would require a much larger study. For example, it would be necessary to measure prey profitability, which depends on searching and handling parameters, nutritional composition, gut transit times, and indices of digestibility for different prey types and sizes (e.g. Green and Tyler 1989), along with effective soil and surface-active invertebrate sampling to measure prey abundance.

ACKNOWLEDGEMENTS

This work was part funded by the European Agriculture Guidance and Guarantee Fund as part of the RSPB's three year Cytgord Cefn Gwlad project, which aimed to restore the balance between wildlife and agriculture in Wales. The authors would like to thank Dr Debbie Pain and Dr Jeremy Wilson; David Lamacraft, Liz Muirhead, Andy Harris, Sarah Dawkins, James Millet, Anne Butler and Stephanie Fuller who all assisted with data collection; Alastair Moralee and Reg Thorpe, who provided site information and practical support; and CCW for the loan of site maps, and provision of habitat information. Andrew Young wrote the macro to carry out the re-sampling. The authors are particularly grateful to all the landowners and tenants who allowed us access to their land, and without whom this work would not have been possible.

REFERENCES

Bignal, E.M., McCracken, D.I., Stillman, R.A. & Ovenden, G.N. 1996. Feeding behaviour of nesting Choughs in the Scottish Hebrides. *J. Field Ornithology* **67**: 25-43.

BirdLife International. 2004. *Birds in Europe: population estimates, trends and conservation status*. Cambridge, UK: Birdlife International. (Birdlife Conservation Series No. 12).

Bullock, I.D., 1980. Some aspects of the ecology of the Chough *Pyrrhocorax pyrrhocorax*. Unpublished MSc thesis, University of Wales Bangor.

Green, R.E. and Tyler, G.A. 1989. Determination of the diet of the Stone Curlew (*Burhinus oedicnemus*) by faecal analysis. *J. Zool., Lond.* **217:** 311-320.

Gregory, R.D., Wilkinson, N.I., Noble, D.G., Robinson, J.A., Brown, A.F., Hughes, J. Proctor, D.A., Gibbons, D.W. & Galbraith, C.A. 2002. The population status of birds in the United Kingdom, Channel Islands and Isle of Man: an analysis of conservation concern 2002-2007. *British Birds* **95**: 410-450.

McCracken, D.I. and Foster, G.N. 1993. Surface-active invertebrate communities and the availability of potential food for the Chough, *Pyrrhocorax pyrrhocorax* L, on pastures in north-west Islay. *Pedobiologia* **37:** 141-158.

McCracken, D.I., Foster, G.N., Bignal, E.M. & Bignal, S. 1992. An assessment of Chough *Pyrrhocorax pyrrhocorax* diet using multivariate analysis techniques. *Avocetta* **16:** 19-29.

Meyer, R.M. 1990. Observations on two Red-billed Choughs *Pyrrhocorax pyrrhocorax* in Cornwall: habitat use and food intake. *Bird Study* **37:** 199-209.

Meyer, R.M. 199. *The feeding ecology of the red-billed chough Pyrrhocorax pyrrhocorax in west Wales and the feasibility of re-establishement in Cornwall.* Unpublished PhD. thesis, University of Glasgow.

Meyer, R.M., Buckland, P.C. & Monaghan, P. 1994. The diet of the Chough *Pyrrhocorax pyrrhocorax* as indicated by analysis of digested prey remains. *Avocetta* **18:** 95-106.

Moreby, S.J. 1988. An aid to the identification of arthropod fragments in the faeces of gamebird chick (Galliformes). *Ibis* **130:** 519-526

Roberts, P. 1982. Foods of the Chough on Bardsey Island, Wales. *Bird Study* **29:** 155-161.

Sanchez-Alonso, C., Ruiz, X., Blanco, G. & Torre, I. 1996. An analysis of the diet of Red-billed Chough *Pyrrhocorax pyrrhocorax* nesting in NE Spain, using neck ligatures. *Ornis Fennica* **73:** 179-185.

Stephens,A. 1996 *Dictionary of agriculture 2nd ed.* Collins, Middlesex UK.

Sutherland,W.J. Newton,I. & Green,R.E. 2004 *Bird ecology and conservation: a handbook of techniques.* Oxford Uni Press, Oxford UK

Thorpe, R.I. and Johnstone, I. 2003. The status of Chough (*Pyrrhocorax pyrrhocorax*) in Wales 2002. *Welsh Birds* **3:** 354-362.

Thorpe, R.I. and Young, A. 2002. The population status of birds in Wales: an analysis of conservation concern, 2002-2007. *Welsh Birds* **3:** 289-302,

Welsh Assembly Government .2003. *Going Wild in Wales. List of species and habitats of principle biodiversity importance for the conservation of Biological diversity.*

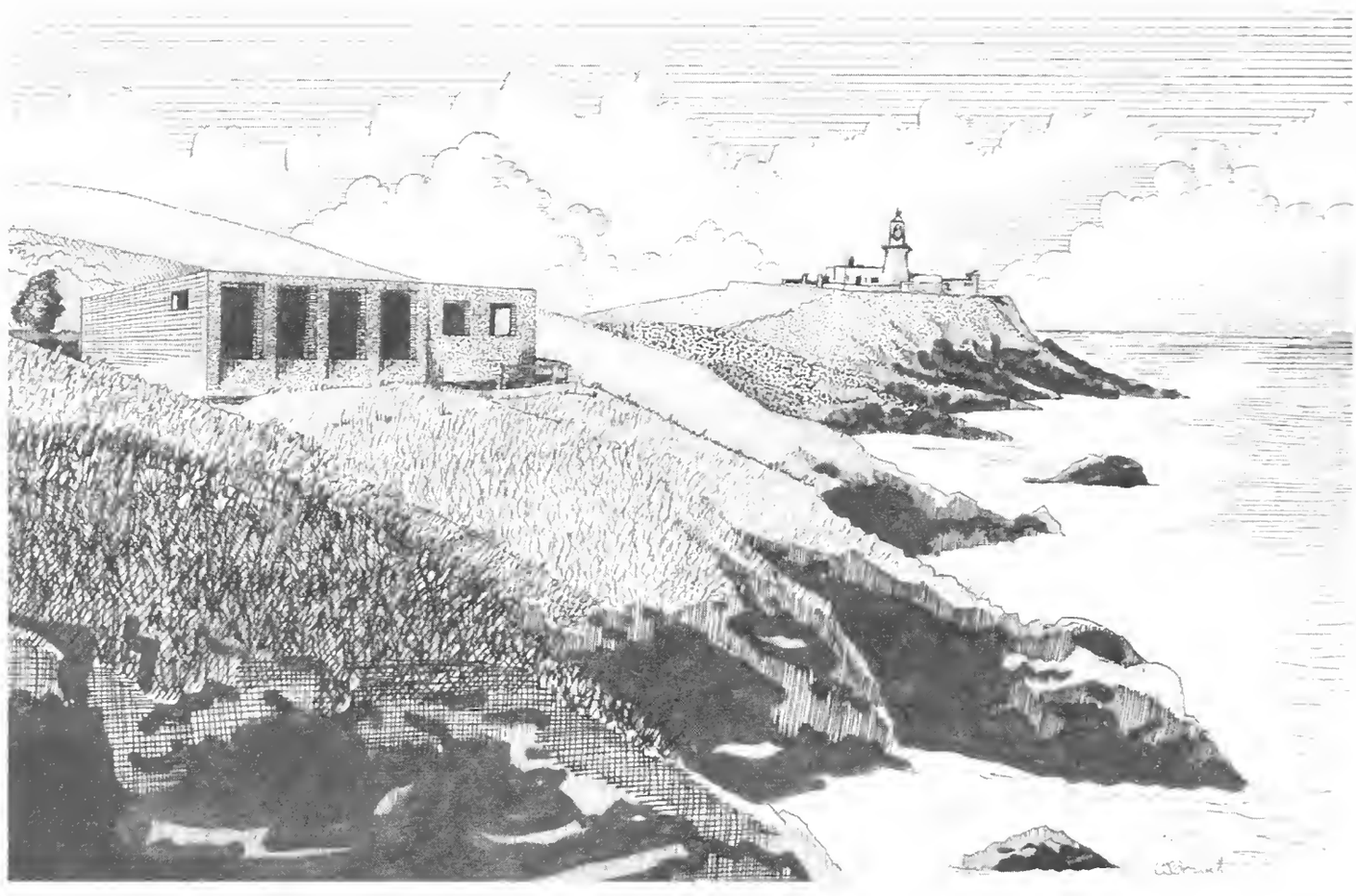
Whitehead, S., Johnstone, I. & Wilson, J. In press. Choughs *Pyrrhocorax pyrrhocorax* breeding in Wales select foraging habitat at different spatial scales. *Bird Study*

Wright, J., Stone, R.E. & Brown, N. 2003. Communal roosts as structured information centres in the Raven, *Corvus corax. J. Anim. Ecol.***72:** 1003-1014.

AUTUMN SEA-WATCHING AT STRUMBLE HEAD, 1994-2003

— JONATHAN GREEN —

Crud yr Awel, Bowls Road, Blaenporth, Cardigan. SA43 2AR.



SUMMARY

Sea-bird movements passing Strumble Head, Pembrokeshire were recorded over ten years, 1994-2003. The data from these are analysed to show relative species abundance, migration seasons and occurrence in relation to wind factors.

During the period 1,071 Red-throated Divers, 92 Black-throated Divers, 300 Great Northern Divers, 1 Soft-plumaged Petrel, 32 Cory's Shearwaters, 64 Great Shearwaters, 565 Sooty Shearwaters, 1,278 Mediterranean Shearwaters, 1 Little Shearwater, 3 Wilson's Petrel, 634 Leach's Petrels, 12,233 Common Scoter, 121 Grey Phalarope, 442 Pomarine Skua, 2,209 Arctic Skua, 200 Long-tailed Skua, 1,785 Great Skua, 323 Little Gull, 123 Sabine's Gull, 4,999 Sandwich Tern, 734 Black Tern and 82 Little Auks were recorded. Commoner species such as Gannet, Fulmar, Manx Shearwater and the larger Auks occur in small to large numbers on a daily basis and are not included. Annual minimum and maximum, maximum daily counts and passage periods are described.

Virtually all movements are of birds going south-west out of the Irish Sea. It is suggested that peak passage days involve mainly birds that have been blown up into the southern Irish Sea, by south-westerly winds, departing out into the south-west approaches when the wind eases or turns allowing them to do so. The largest counts relate to when the winds veer west or north-west, blowing these birds closer to the Pembrokeshire coast.

In autumns with few SW winds there is reduced passage, relating to birds that have either entered the Irish Sea by the narrow opening off Scotland or, in the case of some Skuas and Scoter, overland from the North Sea.

INTRODUCTION

Lying five miles west of Fishguard, Pembrokeshire, Strumble Head is the top sea-watching site in Wales. Strumble also has the luxury of a refurbished ex-World War II lookout, at about 50m above sea-level, which allows observers some degree of protection from the elements.

The idea of sea-watching from Strumble originated back in the 1960's but it wasn't until Graham Rees returned to the county in the early 1980's that it took off. The development of sea-watching at Strumble is almost totally down to this one man. A man who has spent hundreds if not thousands of hours gazing out to sea from this lookout. This paper summarises all the available data from Strumble Head during the period 1994-2003. And it pays homage to the dedication provided by the numerous observers who spend many days staring out at the sea from the Strumble Head lookout.

SEA-BIRD MOVEMENTS

The autumn seabird passage around the UK takes several routes (fig. 1). Most birds travel down either the east coast, through the Channel and out into the Atlantic (1) or down the west coast of Scotland and Ireland (2). Smaller numbers take this latter route then divert to move down the Irish Sea past the Welsh and Cornish coasts before joining the others (3). Strumble Head is ideally positioned, at the south eastern end of the Irish Sea to observe this passage. Indeed even in light "unfavourable" winds Skuas, Terns, Divers and Scoter are often observed at Strumble as they exit the Irish Sea.

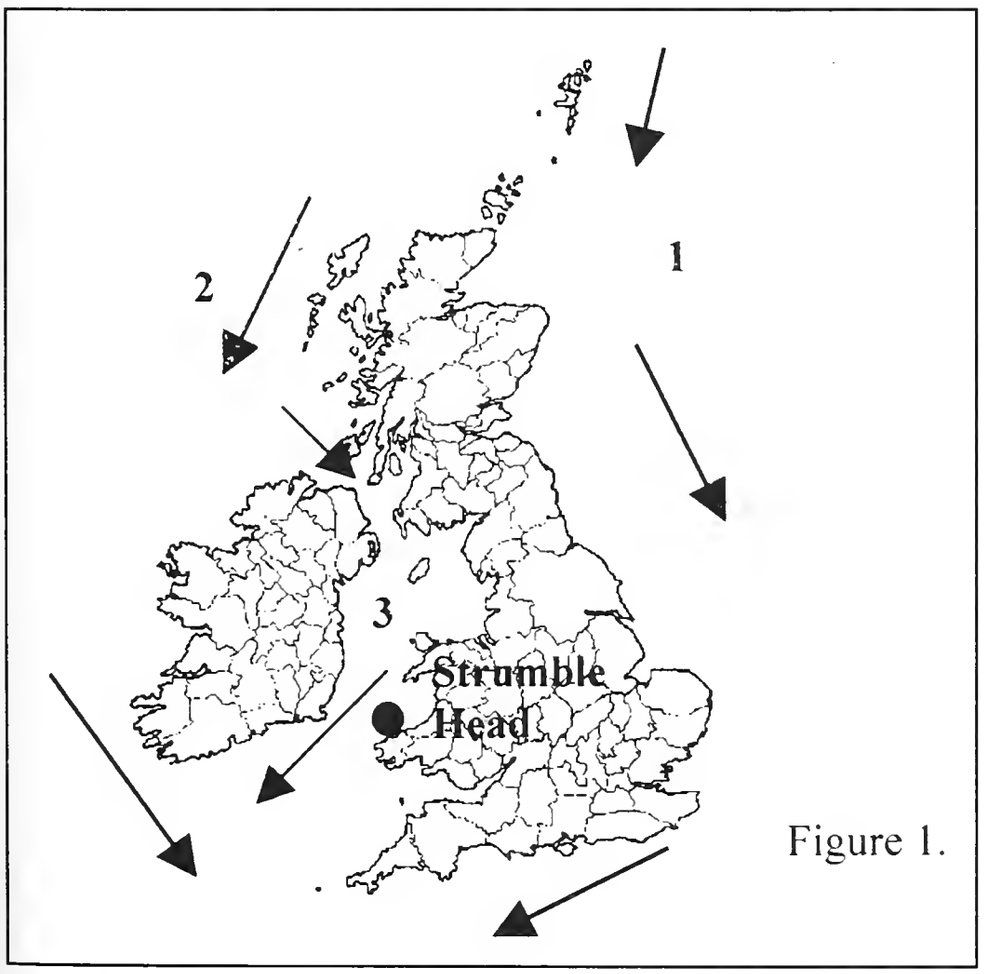


Figure 1.

South-westerly winds may push various species back up into the southern Irish Sea (Fig. 2). It is on or following these winds that the larger counts have been made, usually around the end of August to mid September.

The "ideal conditions" are prolonged south-westerly gales followed by strong west or north-

westerly gales. The initial gales push birds from much further south into the Irish Sea (Fig. 2) and the W / NW winds then push them further inshore, allowing closer views.

These "classic" conditions occur only every few years but have brought large numbers of both Great and Cory's Shearwaters, all 4 species of Skua, Sabine's Gulls and Leach's Petrels, as well as major rarities such as Little Shearwater, Wilson's Petrel and Soft-plumaged Petrel.

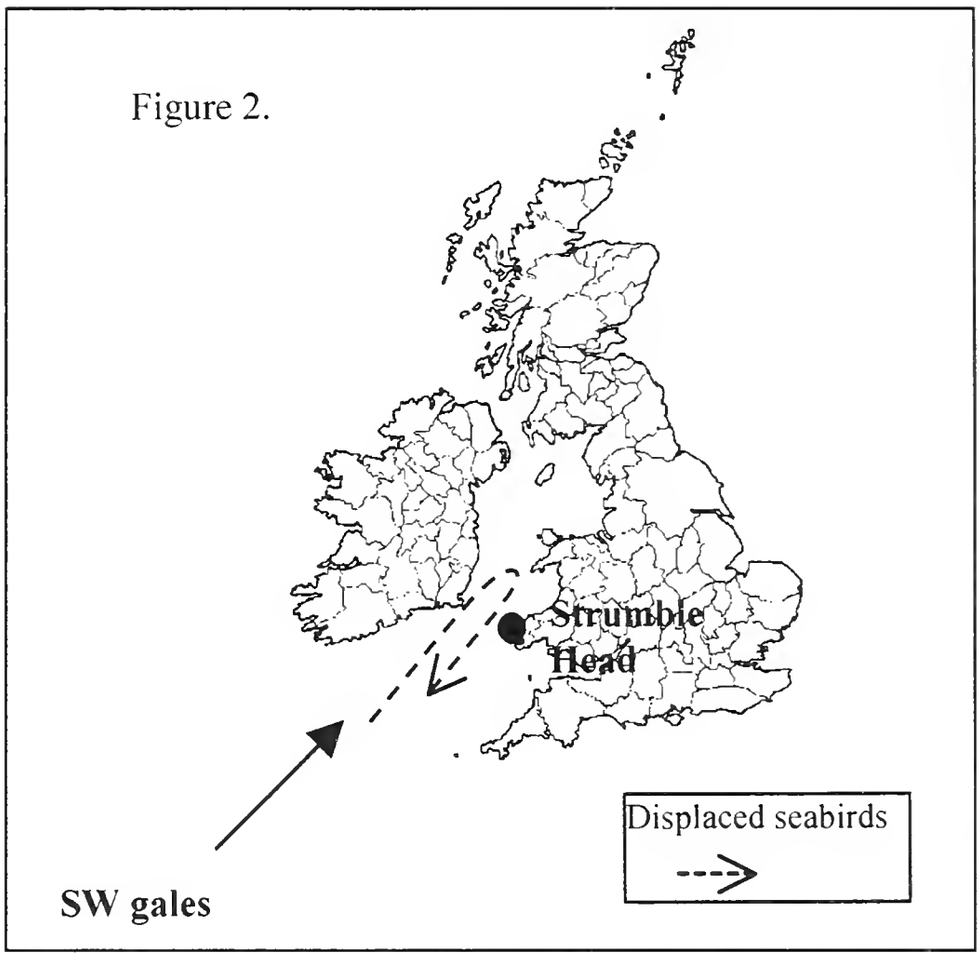


Figure 2.

METHODS

For many years the coverage was restricted to weekends and holidays but with the increasing number of avid observers and the retirement of Graham Rees, coverage in the early 1990's onwards became almost daily, from early July until the end of October. Unfortunately there is no formal log for the site, where details of sea-bird passage can be stored, along with times of watches, weather conditions and numbers of observers. If there was such a log, then a more meaningful analysis could be carried out, linking species occurrence more closely with weather patterns.

Observers do, however, send in their records to the County Recorder, who has entered them onto species record cards for each year. It is from these record cards that the data on passage have been extracted for this paper. For the rarer species only those records that have been accepted by BBRC or WRP / WRAG have been included. All this data was analysed and published in 2004 in the book, Birding in Pembrokeshire (Green and Roberts).

The data have been analysed into ten day periods for each month, i.e. $1^{st} - 10^{th}$, $11^{th} - 20^{th}$, 21^{st} – end of the month. Autumn passage usually starts towards the end of July, peaking in September / October and finishing mid November. It must be noted that although there was a high level of coverage, not all days were equally watched – the greatest amount of effort and time going into the most productive periods. Similarly coverage in one year is never the same as the next but by analysing data into ten-day periods some analysis is possible. This data set is the most complete that has ever been gathered.

Passage can be observed from day-break onwards, often dying off by mid-morning but sometimes picking up again in late afternoon – early evening. Obviously in times of

optimal conditions passage continues all day, although it is usually most heavy before 10 am. Most seabirds move from East to West at Strumble, when passing out of the Irish Sea. The most obvious exception to this is of Manx and Mediterranean Shearwaters, which in early autumn pass up and down the coast on feeding forays.

OBSERVATIONS

Table 1 summarises the totals of the more numerous species, along with the minimum and maximum annual totals (with their respective years); the maximum recorded in one day (with its date); the earliest recorded and latest recorded dates during the ten years. It must be noted that for some of the early autumn migrants, such as Common Scoter, the earliest date may just refer to the first date of sea-watching that year and not the beginning of passage. The commoner species, such as Gannet, Fulmar, Kittiwake, Guillemot, Razorbill and Puffin are recorded almost daily in variable numbers and as such are beyond the scope of this paper.

Table 1. Summary table of observations.

Species	Total No. Recorded (1994-2003)	Annual Variability		Max. Day Total	Earliest Date	Latest Date
		Min.	Max.			
Red-throated Diver	1,071	59 (1997)	207 (2000)	66 (14/12/00)	July 11th	Dec. 31st
Black-throated Diver	92	2 (1995)	21 (1999)	5 (29/11/99)	Aug. 20th	Dec. 28th
Great Northern Diver	300	12 (1995)	71 (1999)	13 (31/12/94)	Aug. 13th	Dec. 31st
Cory's Shearwater	32	0 (2002 & 3)	14 (1999)	6 (15/8/99)	July 9th	Nov. 29th
Great Shearwater	64	0 (94, 96,2003)	29 (2002)	25 (31/8/02)	Aug. 7th	Oct. 2nd
Sooty Shearwater	565	12 (2003)	119 (1994)	35 (13/9/01)	July 21st	Dec. 14th
Mediterranean Shearwater	1,278	65 (1998)	402 (1999)	37 (22/9/03)	June 30th	Jan. 4th
Leach's Petrel	634	0 (2002)	260 (2001)	122 (16/9/01)	Aug. 3rd	Dec. 26th
Common Scoter	12,233	2,150 (1996)	6,093 (2000)	347 (29/7/02)	May 30th	Dec. 31st
Grey Phalarope	121	4 (2002)	35 (2001)	10 (8/10/01)	Aug. 17th	Nov. 29th
Pomarine Skua	442	7 (2002)	149 (1999)	27 (6/11/99)	July 15th	Jan. 3rd
Arctic Skua	2,209	147 (1996)	323 (1994)	52 (6/9/97)	June 13th	Dec. 19th
Long-tailed Skua	200	4 (2002)	53 (1999)	13 (3/10/99)	Aug. 2nd	Dec. 3rd
Great Skua	1,785	137 (2002)	211 (1998)	42 (27/10/98)	June 29th	Jan. 3rd
Little Gull	323	8 (1998)	67 (2003)	46 (15/11/03)	Aug. 18th	Jan. 24th
Sabine's Gull	123	5 (1994 & 8)	42 (1997)	12 (13/9/97)	Aug. 11th	Jan. 3rd
Sandwich Tern	4999 (1994-2001)	617 (1996)	1,183 (1999)	131 (30/9/99)	June 22nd	Nov. 15th
Black Tern	734	7 (2003)	327 (1997)	112 (27/8/97)	Aug. 10th	Nov. 7th
Little Auk	82	2 (98, 00, 03)	33 (1995)	13 (24/9/95)	Sept. 12th	Dec. 4th

RED-THROATED DIVER

Gavia stellata *TROCHYDD GYDDFGOCH*

In autumn, large numbers were recorded annually passing Strumble Head on their way south. The total number of individuals passing in 10-day periods is shown in Fig. 3. Passage starts in early September, with a peak in early October, then again during the first part of November before falling off. The peaks at the end of November – early December are difficult to explain. Certainly some of these birds may relate to storm-displaced birds, moving back out of the Irish Sea. However the end of December is so pronounced that it is more likely to be due to birds moving further south, from northern Cardigan Bay into Carmarthen Bay. A similar pattern has been recently noted at Point Lynas, Anglesey (Green *et al*).

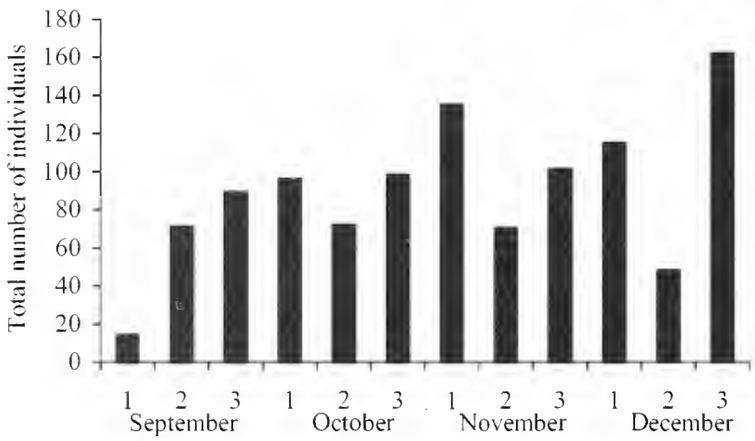


Fig. 3 Passage of Red-throated Divers off Strumble Head

BLACK-THROATED DIVER

Gavia arctica *TROCHYDD GYDDFDDU*

Between 6 and 10 individuals are recorded passing Strumble each year, mainly in late October and November (Fig. 4). The peak year was 1999, when a total of 21 were logged, including 11 in November (6 during the 1st – 3rd and 5 on the 29th) and 4 in December. It must be noted however that in some winters "Black-throats" winter off Strumble and this may distort these figures.

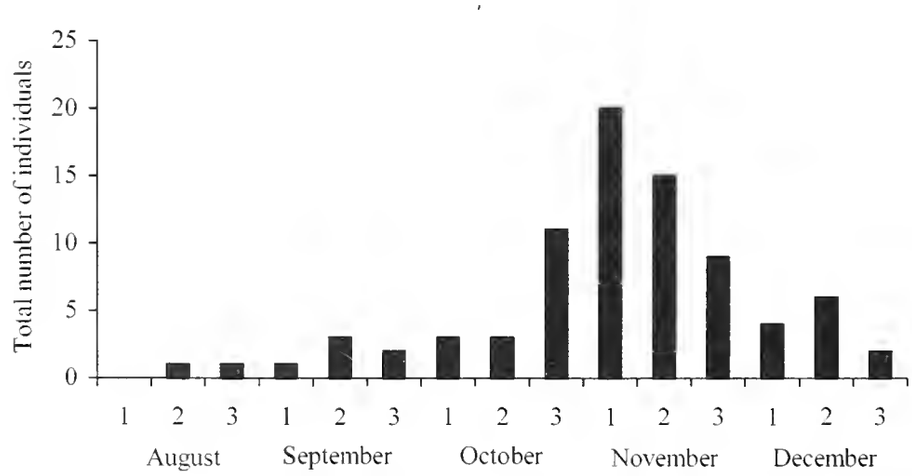


Fig. 4 Passage of Black-throated Divers off Strumble Head

GREAT NORTHERN DIVER

Gavia immer *TROCHYDD MAWR*

Autumn passage is recorded annually, with between 19 and 71 recorded each year. Passage usually starts in mid-September (occasionally mid-August) and lasts until the end of the year (Fig. 5). Peak passage is at the end of October and beginning of November. The large peak at the end of December could refer to storm driven individuals moving in or out of the Irish Sea or alternatively a southward movement as suggested for Red-throated Diver.

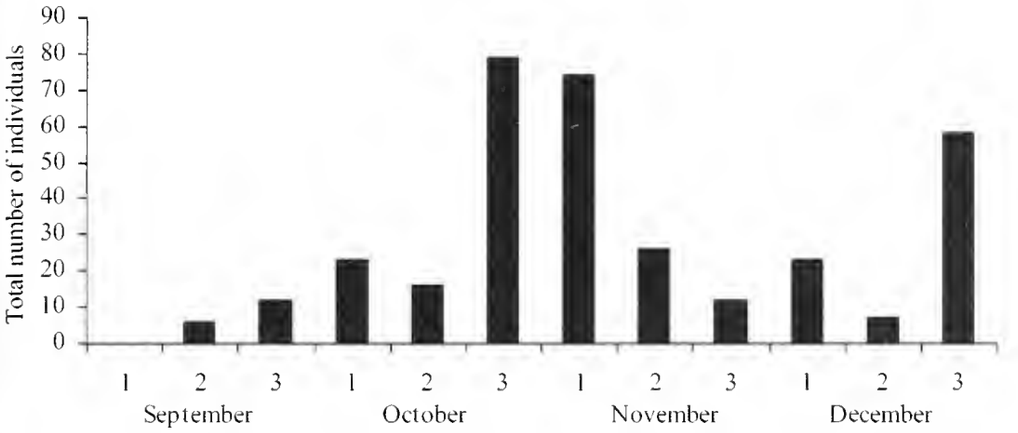


Fig. 5 Distribution of Great Northern Diver

WHITE-BILLED DIVER

Gavia adamsii *TROCHYDD PIGWEN*

An adult passed Strumble Head on Sept. 27th 1999. This was the 2nd Welsh record.

FULMAR

Fulmarus glacialis *ADERYN-DRYCIN Y GRAIG*

Fulmars breed locally and are seen daily in numbers up to 100. The only large movements noted were 560 in 3 hrs. on Nov. 15th and 500 on Dec. 3rd 1998. Blue morphs were reported on Oct. 3rd 1994, Sept. 10th 1998 and Oct. 27th 2002.

"SOFT-PLUMAGED PETREL"

Pterodroma madeira/feae/mollis *PEDRYN MWYTHBLU*

The only record was of one on Oct. 4th 1996. This was the 2nd Welsh record. Interestingly the bird was seen on three occasions during the day, on each occasion moving west past the Head. Presumably it was making some sort of a circuit into and out of the Irish Sea.

CORY'S SHEARWATER

Calonectris diomedea *ADERYN-DRYCIN CORY*

Cory's are recorded most autumns off Strumble Head. Since 1975 there have been 43 accepted individuals, 32 of which were in the period of this review. 1999 was a bumper year when 14 were recorded. The November bird (Nov. 29th 1999) was the latest Welsh record and was seen after a "good" gale preceded by two days of strong SW winds – presumably pushing the bird up from a long way south.

Figure 6 shows the total numbers of the large shearwaters recorded. Cory's Shearwaters are significantly less numerous than Great Shearwaters. Both are observed only during "classic conditions" as described earlier, a couple of days of strong SW winds followed by a W or NW, usually in the period of late August to mid September.

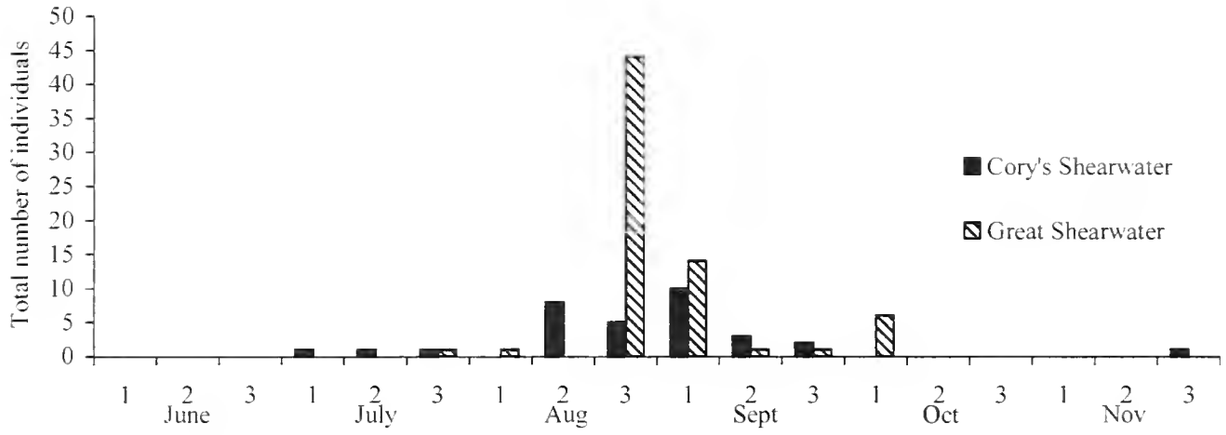


Fig. 6 Distribution totals of Cory's and Great Shearwaters

GREAT SHEARWATER

Puffinus gravis *ADERYN-DRYCIN MAWR*

Great Shearwaters are reported in larger numbers than Cory's and on a virtually annual basis. There have been 117 accepted individuals off Strumble Head, 64 of which were during the period of this review. As with Cory's, 1999 was a bumper year with 50 individuals recorded off Pembrokeshire though only 11 were off Strumble, while a total of 43 were recorded in Pembrokeshire in 2002, 29 of them from Strumble including a total of 25 on Aug. 31st.

Occurrence of "large Shearwaters"

No other scarce migrant varies in numbers so dramatically from year to year as Cory's Shearwater. 1998 was the largest influx ever to reach the UK with 5,114 individuals recorded, mainly in the SW. Birds were thought to have been displaced north by strong warm, southerly winds, generated by a deep depression to the west of Ireland, in early September. Counts off Porthgwarra, Cornwall, included 3,500 on Sept. 5th, 256 on the 6th and 60 on the 7th. During this year there were only 3 records at Strumble, all of singles, on Aug. 21st and Sept. 10th & 13th. Presumably the latter two were part of this influx, just blown further NE.

1999 produced the second highest UK annual total of Cory's Shearwater (3,372), with 1,878 counted from the Isles of Scilly, 1,411 off Cornwall, 9 off Devon and 35 from pelagics. Peak of this passage was mid-September (e.g. 1,000 off Galley Head, Co. Cork on the 18th), while of the 14 seen from Strumble only 3 were seen during this period. Gales in August brought birds into the south Irish Sea, and 6 were seen off Strumble on Aug. 15th, with one the following day (one from north Wales at Point Lynas, Anglesey on Aug. 30th). Similarly there were large numbers of Great Shearwaters seen in the SW, including 2,000 off Porthgwarra on Aug. 17th, 230 off there on Sept. 8th, 1,138 off Scilly on the 18th and 266 off Berry Head, Devon on the 23rd. 50 Great Shearwaters were recorded off Pembrokeshire, although the majority were from pelagic trips; 11 were seen off Strumble Head, including 4 on Oct. 2nd; together with a record 402 Mediterranean Shearwaters. A large number of Basking Sharks *Cetorhinus maximus* were also noted during this period, suggesting warmer than usual sea temperatures, resulting in increased feeding opportunities in the south-westerly approaches.

2002 was a below average year for Cory's Shearwater in the UK with only 225 recorded. Of these 205 were seen in the SW (105, off Cornwall, 60 from Scilly and 37 at sea in the

Scilly / Sole area) but none from Strumble. Large numbers of Great Shearwaters were noted off Cornwall in late August, including 696 off Porthgwarra on the 30th. Some of this large movement must have pushed up into the southern Irish Sea. Pelagic trips off Pembrokeshire to the "Celtic Deep" area, counted at least 14 individuals during August and early September. One was seen off Strumble on July 30th and another on Aug. 24th, then a SW gale, which backed westerly on the 31st brought 25 (the highest daily count) off Strumble. 2 others were seen in the 1st week of September. This resulted in the record annual count of 29 from Strumble.

SOOTY SHEARWATER

Puffinus griseus *ADERYN-DRYCIN DU*

Passage numbers in the period under review varied between 45 and 119 and thus have not approached the maxima of the 1980's, e.g. 397 in September 1983. Similarly, the highest daily count varied between 8 in 1996 and 35 in 2001.

Only 12 were recorded during the whole of the 2003 autumn off Strumble Head, the lowest annual total since counts began in 1980. Both this and 1993 (when only 14 logged) were autumns dominated by easterly winds.

Figure 7 compares the seasonal distribution of Sooty and the more numerous Mediterranean Shearwaters. Sooty Shearwaters have one peak passage (late August - early September) compared to Mediterranean's two peaks, at the end of August / early September and early October.

The highest annual count of 119 was in 1994, a year when over 1,000 were recorded in the UK and Ireland (50 at Pendeen and 200 at Rocky Point, Co. Donegal on Aug. 28th). The largest day count, 35 on Sept. 13th 2001 was also during a large movement off Ireland. 2,000 were counted passing Kilcummin Head, Co. Mayo, in the first 2 weeks of September and it has been estimated that over 12,000 birds must have passed the Irish Coast during this period.

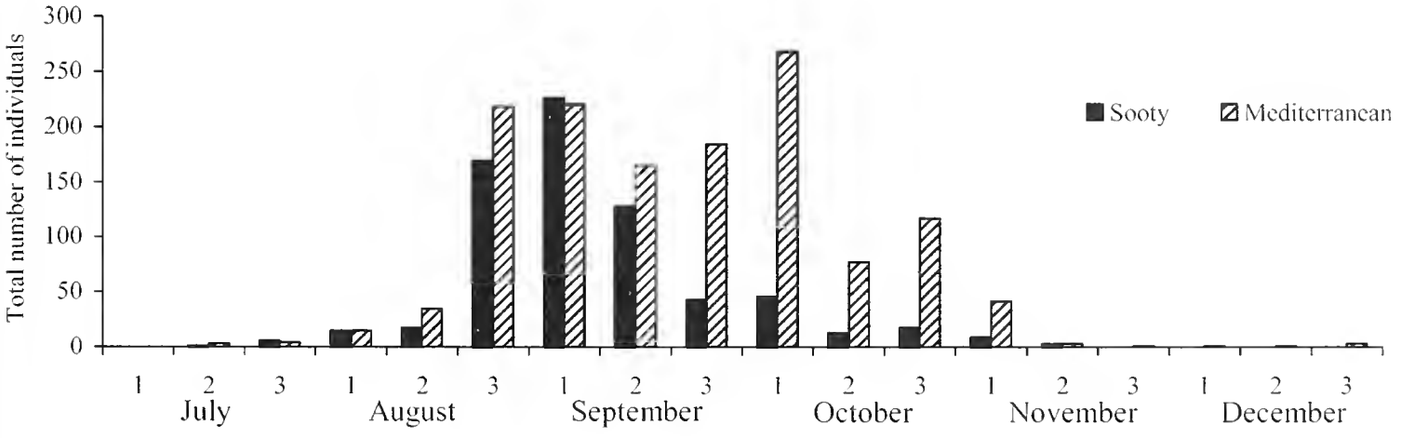


Fig. 7 Distribution of Sooty and Mediterranean Shearwaters

MANX SHEARWATER

Puffinus puffinus *ADERYN-DRYCIN MANAW*

Many of the 150,000 or so pairs nesting on the Pembrokeshire Islands (Skomer, Skokholm and Middleholm etc), plus those from Bardsey, feed in the Irish Sea. Large numbers, in the thousands, can be seen throughout the summer and early autumn moving backwards and forwards past Strumble Head. Although most have departed Welsh waters

by the end of October, a few are reported almost annually off Strumble Head as a result of gales in November, December and January.

MEDITERRANEAN SHEARWATER
Puffinus mauretanicus *ADERYN-DRYCIN MOR Y CANOLDIR*
A regular visitor off Strumble Head. 1999 was an exceptional year with 402 individuals - much higher than the previous highest annual count of 249 in 1990. Passage occurs from mid July until the beginning of November (Fig. 7).

Winter records are few and relate to gale displacement, singles on: Dec. 29th 1998, Jan. 4th, Dec. 2nd 2001, Jan. 29th & Feb. 2nd 2002 and Jan. 23rd, 26th & 28th 2003 (possibly the same individual).

LITTLE SHEARWATER
Puffinus assimilis *ADERYN DRYCIN BACH*
A male spent the summers of 1981 & 1982 on Skomer. This individual might have been responsible for the following accepted records off Strumble Head on Sept. 27th 1982, Oct. 16th 1983 and Sept. 21st 1984. Since then there were 2 sightings on Oct. 7th 1988 (perhaps the same bird going round twice) and singles on Nov. 5th 1989 and Sept. 12th 1997. The latter was on a strong W/NW wind.

WILSON'S PETREL
Oceanites oceanicus *PEDRYN WILSON*
The first county record was off Strumble Head on Sept. 3rd 1986. Since then individuals have been acceptably recorded there on Sept. 16th 1990, Sept. 11th 1998 and two on Sept. 5th 1997. The last two were both seen after moderate SW winds lasting for a few days backed NW.

STORM PETREL
Hydrobates pelagicus *PEDRYN DRYCIN*
Breeds locally and individuals are recorded off Strumble Head from spring until early October but one was observed on the late date of Dec. 12th in 1999. Winter records are extremely unusual, a single was seen off Strumble Head on Jan. 7th 2002.

LEACH'S PETREL
Oceanodroma leucorhoa *PEDRYN GYNFFON-FFORCHOG*

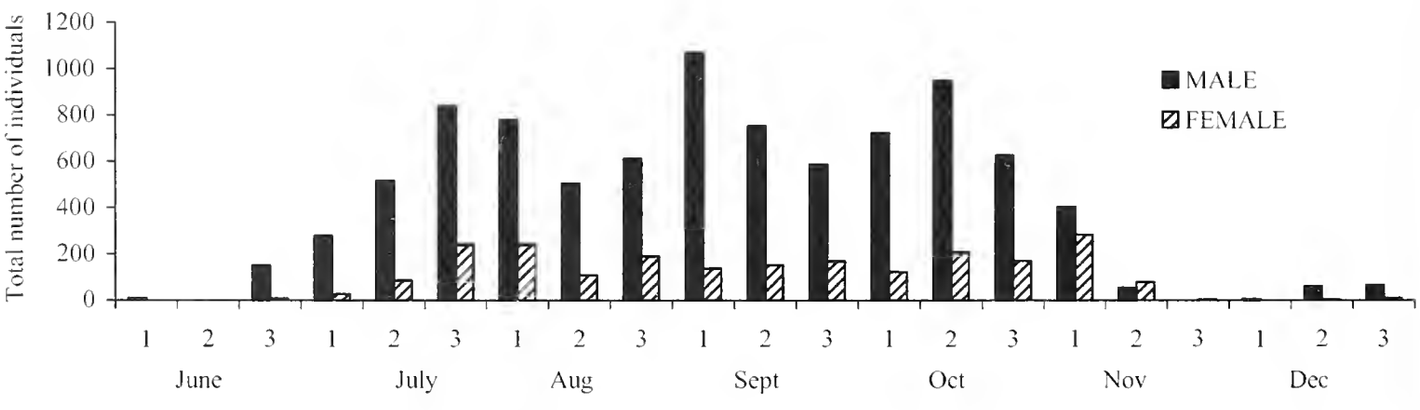


Fig. 8 Distribution of Leach's Petrels

Leach's Petrels are recorded almost annually in autumnal gales (NW or N usually), with peak passage in mid-September (Fig. 8). The number recorded each year varies depending on the frequency and strength of these gales. Sometimes as few as 19 have been recorded (1994) but 260 were logged in 2001; 122 of these were on one day, Sept. 16th. Birds have been recorded between Aug. 4th and Nov. 8th but a late one was seen on Dec. 26th 1997.

CORMORANT

Phalacrocorax carbo *MULFRAN*

A local breeding sea-bird often seen passing in small numbers. In autumn many Cormorants pass south, and 203 were logged in 1995, 240 in 1999 and 309 in 2000. Passage starts mid August and usually continues until the end of October but, in 1999, not until the end of November. In 2003 only 79 were logged, whereas 255 were counted during a similar period off Skokholm – presumably they were just passing further out.

SHAG

Phalacrocorax aristotelis *MULFRAN WERDD*

As with Cormorants, Shags breed locally and are often seen passing Strumble in small numbers. However there is an autumn movement, 167 were logged in 1999 and 109 in 2000.

COMMON SCOTER

Melanitta nigra *MOR-HWYADEN DDU*

Common Scoter can be seen passing Strumble Head on their autumn migration, probably into Carmarthen Bay, from early June onwards. The totals logged range between 1,492 – 6,093 birds.

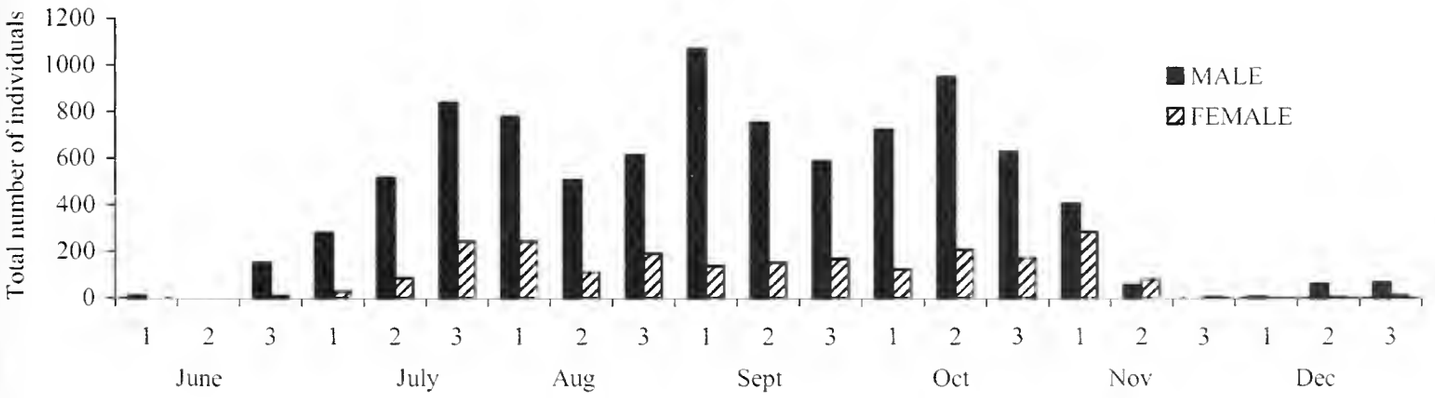


Fig. 9 Totals of male and female Common Scoters logged passing Strumble Head 1994-1999

During 1994-1999 the numbers of "male-type" and "female-types" were logged. Males greatly outnumbered females in all months (Fig. 9). Starting in late June, there were apparent small peaks in late July, early September and mid-October. However some of these peaks may relate to adverse weather (SW gales resulting in displacement) and observer coverage. By mid-November passage has all but finished.

It has been suggested that the first peak in late July, relates to birds on their way to moult, while the later peaks are of pre-moulted individuals. In Carmarthen Bay 80 – 90% of

birds are males in September, the proportion of females then increasing until March - April when there is nearly a 50:50 ratio (L. Smith pers. com.). The Strumble data agree with the high dominance of males in autumn but the number of females passing later does not increase sufficiently to alter the sex ratio significantly. It is assumed therefore that the increase in the ratio of females in Carmarthen Bay during late winter is not only due to more females arriving but also due to post-moult movement of males away, probably to the south towards the coast of Holland and France.

Initial results from Point Lynas (S. Whitehead pers. com.), is that males move mostly in autumn and females later. This does not appear to be the case in Pembrokeshire. Perhaps the larger number of females reported from Point Lynas relate to the wintering flocks in north Cardigan Bay and the north Wales coast, and not those moving down to Carmarthen Bay.

GREY PHALAROPE

Phalaropus fulicarius *LLYDANDROED LLWYD*

A total of 121 were observed in the ten years, with between 5 and 35 individuals being recorded each year. Passage may start in late August and go on until the end of November (Fig. 10).

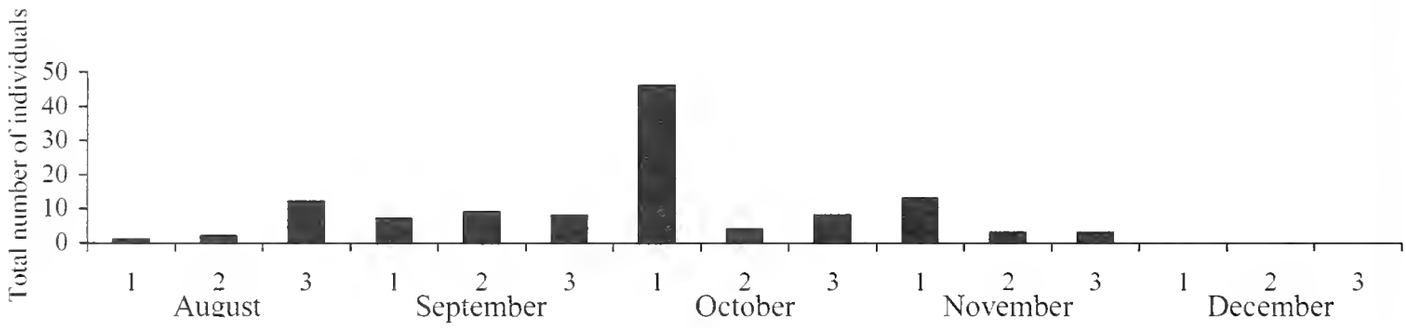


Fig. 10 Distribution of Grey Phalaropes

In 2001 a record total of 35 were counted passing Strumble, during the period Sept. 6th – Oct. 9th, 28 of which were in this first ten-day period of October, including a new daily maximum of 10 which were on Oct. 8th. This was a peak year in the UK for Grey Phalarope records, when 1,039 birds were reported. Most were during the 1st ten-day period of October. Counts included 528 from Scilly (including 153 off Tresco on Oct. 1st and 137 off Peninis Head, St. Mary's on Oct. 7th), 219 from Cornwall.

"Skuas"

Of all the species that are regularly seen, it is the Skuas that generate the most interest. Figure 11 compares the number of each of the 3 larger Skuas logged passing Strumble in each of the ten-day periods. Arctic is the most numerous, then Great and finally the much scarcer Pomarine. The peak passage of each also differs, Arctic in late August, Great in early – mid September, while Pomarine shows a small and fairly even passage late August – late October with late peaks in early November and early December (see also Fig. 12).

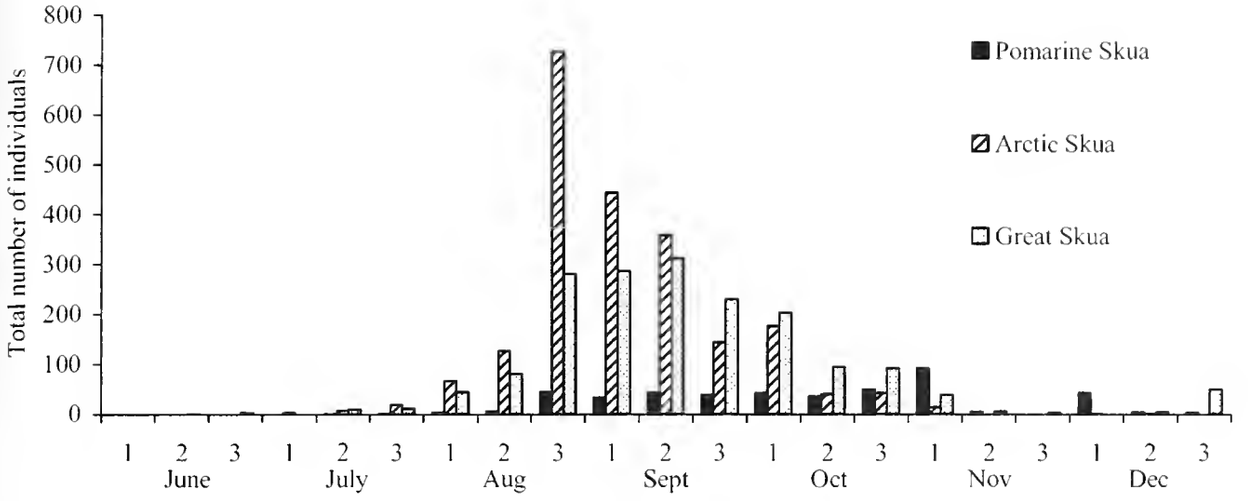


Fig. 11 Distribution of the larger Skuas

POMARINE SKUA

Stercorarius pomarinus *SGIWEN FRECH*

A total of 442 Pomarine Skuas were seen during the 10 years, usually less than 60 are recorded but in 1999 a total of 149 were logged. There appears to be a small passage of "Poms" from early August until the end of October, during which there is little difference in the number of adults, immatures and juveniles. Figure 12 suggests that there is a large passage in early November and early December but of mainly juveniles. This appears to be in line with comments in Olsen and Larsson (1997) that migration is noted in the North Sea from around mid-August, with immatures first, followed by adults, peaking on the British East coast mid – late October. The lack of a distinct peak at Strumble within this period may reflect the low numbers of Pomarine Skuas using the Irish Sea as a migration route compared to those in the North Sea or the difficulty in discerning the age of individual birds.

Juveniles tend to move a little later than adults, with many passing the East coast of Britain in early November or even December (Brown & Grice). This pattern is repeated at Strumble but is skewed by a large passage in 1999, following strong SW winds, which brought a total of 64 birds past Strumble in the first week of November (24 on Nov. 2nd, 10 on the 5th & 27 on the 6th).

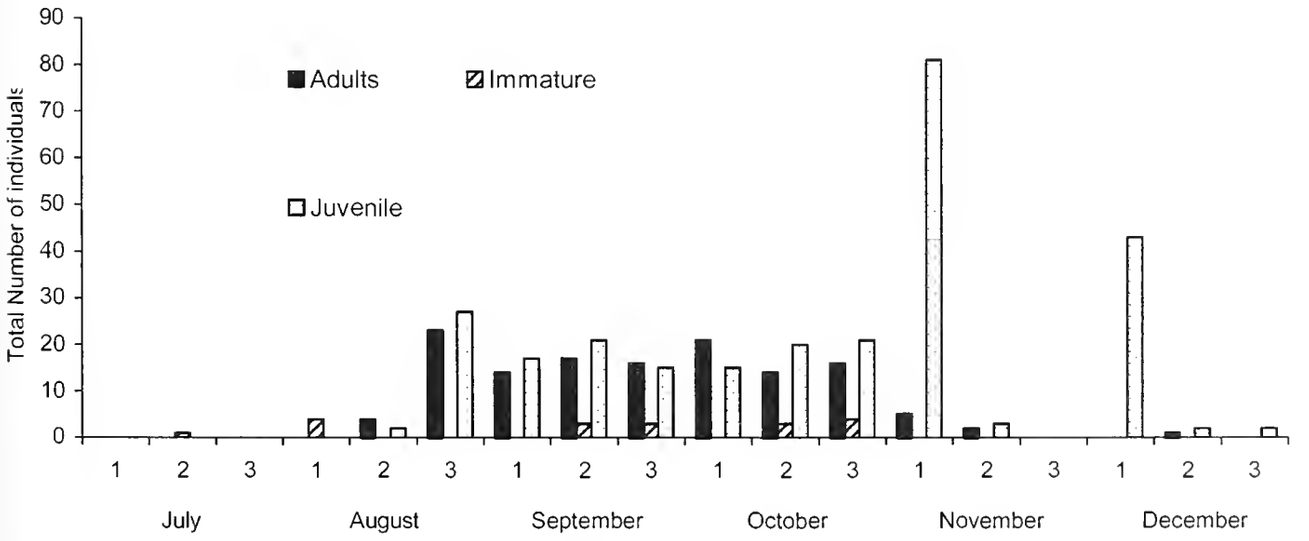


Fig. 12 Distribution of Pomarine Skua

1999 was the peak year for "Poms" off Strumble, when a total of 149 were recorded. Up to end of October it was a fairly average autumn's passage but was followed by a large passage of juveniles in November and December. In this year there was a massive invasion of "Poms" along the Baltic Coast, including 365 at one site in mid October. Counts from the East coast during this period, included 157 past Lochbeg Point, Sutherland on Oct. 21st (mainly juveniles) and 97 off Sheringham on the 6th (the same date as the Strumble daily maximum), 172 on the 17th and 50 on the 18th. No "Poms" were seen from Strumble during the 17th – 18th, as presumably all those that had been blown up into the Irish Sea by the storm, at the beginning of the month had departed from the Irish Sea by then. Subsequent storms at the beginning of December apparently brought stragglers from the south-western approaches back up; 24 were then seen from Strumble including 11on the 3rd and 21 on the 4th.

ARCTIC SKUA

Stercorarius parasiticus *SGIWEN Y GOGLEDD*

A total of 2,209 Arctic Skuas was recorded (5x that of Pomarine), with between 147 and 323 birds annually and up to 52 on one day. Winter records are very rare as virtually all individuals have left Welsh waters by the end of October or early November. During the period two winter singles passed Strumble Head on Dec. 19th 1994 and Dec. 3rd 1999.

The maximum annual count, of 323, was from 1994. The same year saw record sea-watch counts from the East Coast, mainly during the first half of September, associated with SW/NW gales (Sheringham Bird Reports). Passage at Strumble during this period was steady, a total of 109 during the 1st – 16th, but not as dramatic as the 420 Arctics past Sheringham on Sept. 1st.

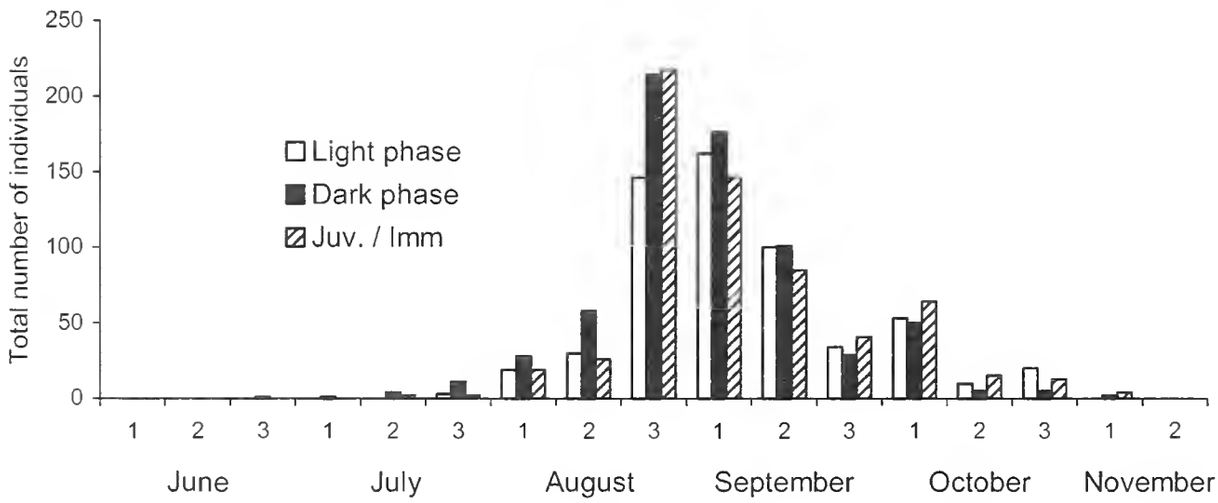


Fig. 13 Distribution of Arctic Skua 1994-2003 (minus 1995)

Figure 13 plots the total number of individuals of each of the "identifiable" adult colour-morphs (intermediate and dark phase combined) and of immatures / juveniles combined during the period 1994 – 2003 (plumage data were not available for 1995). The majority of Arctics logged passing Strumble Head were assigned to one of the 3 categories, those that were have been missed out from this analysis. As with Pomarine, the precise designation of a non-light phase bird (as a intermediate / dark / juvenile) is not always absolutely certain.

All 4 types show a similar distribution. A few start passing in late July, the majority in the period mid-August to early October, and a few stragglers in late October – early November. There was one record of a dark-phase on Dec. 3rd. This species migrates earlier than Pomarine and this earlier departure from Welsh waters explains the lack of records following storms in November - December.

LONG-TAILED SKUA

Stercorarius longicaudus *SGIWEN LOSTFAIN*

Strumble Head is the main site for recording this species in Wales. During the last ten years a total of 200 have been logged in autumn. Usually up to 25 are recorded but 39 were counted in 1994 and 52 in 1999. Passage usually starts early August and ends late October (Fig. 14) but a single was recorded on Dec. 2nd 1996 and a juvenile on Dec. 3rd 1999. Figure 13 summarises all the records where the individuals have been aged. Clearly very few adults (10.3%) or sub-adults (6.5%) were recorded; most were juveniles (83.7%). This accords with suggested movements of adults westwards, after breeding, into the central Atlantic before turning south so that few adults are likely to be in the south-western approaches or the Irish Sea (Olsen and Larsson 1997).

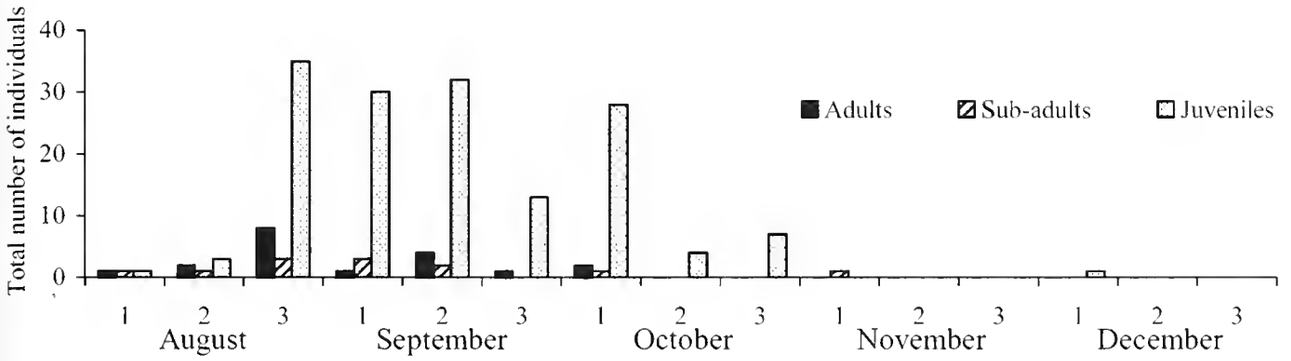


Fig. 14 Distribution of Long-tailed Skuas

The largest annual count was from 1999, when a total of 52 were logged, including 13 on, Oct. 3rd (the maximum day-total is still 18 on Sept. 15th 1991). A total of 24 were recorded in the 6 days, Sept. 30th – Oct. 5th, which coincided with strong SW winds veering to N/NW. Large numbers were also seen elsewhere, including 24 off the south coast of Ireland in late September and 15 off the Bridges of Ross, Co. Clare on Oct. 2nd.

GREAT SKUA

Stercorarius skua *SGIWEN FAWR*

A total of 1,785 Bonxies have been logged, with between 130 and 211 noted annually, from late June until December, although very few were seen after October. Peak passage is late August – mid-September. The largest passage was 42 on Oct. 27th 1998. Best years were those with a high frequency of onshore gales. Northerly gales in late December 1997 brought many Bonxies into Welsh waters. Thus 26 were logged at Strumble Head on the 26th, 3 the following day and singles in early January 1998.

LITTLE GULL

Larus minutus *GWYLAN FECHAN*

Variable numbers are recorded each year: only 8 in 1998 but 67 in 2003 (the largest annual count since 1987), including 46 on Nov. 15th. There was a strong N wind on that day,

which presumably drove individuals down from the north Irish Sea and Liverpool Bay.
More immatures are recorded than adults, with peak passage late-October to mid-November (Fig. 15).

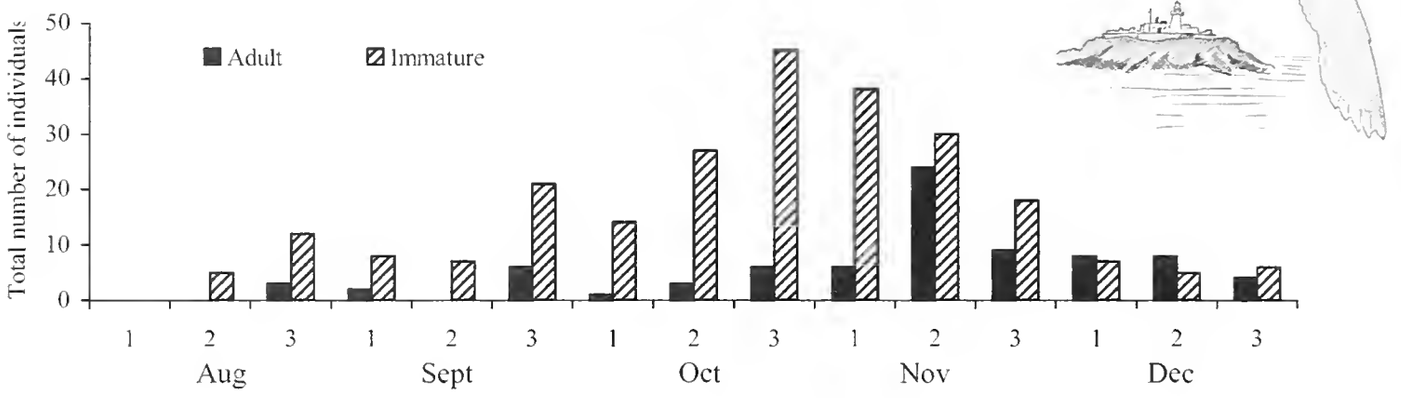


Fig. 15 Distribution of Little Gulls

SABINE'S GULL

Larus sabini *GWYLAN SABINE*

This Nearctic gull has been seen almost annually in autumn since 1980. A total of 130 passed between 1980 and 1992, and a further 126 since then. Juveniles out number adults, with the latter generally passing earlier in the autumn than the former (Fig. 16). A first winter was seen on Jan. 3rd 1999 (the first January record for Wales).

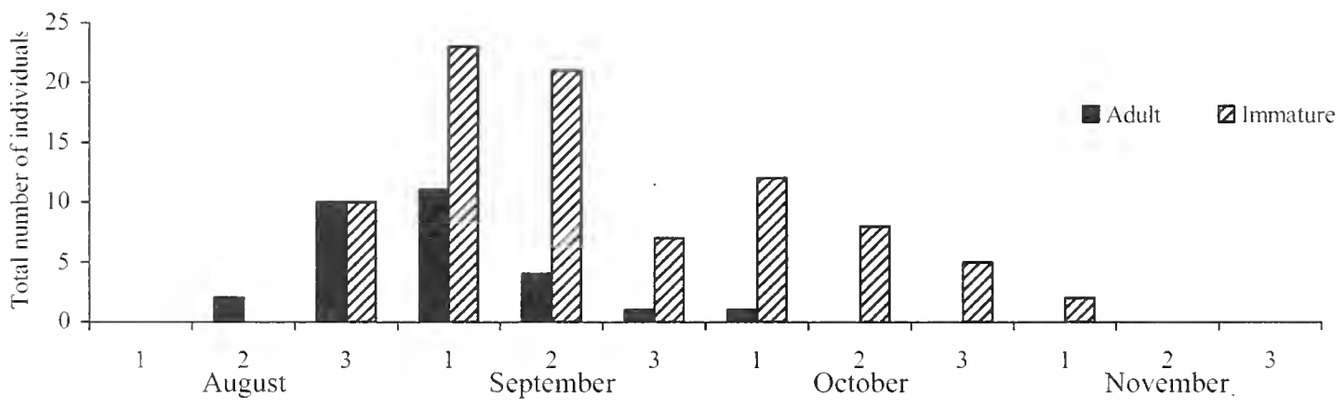


Fig. 16 Distribution of Sabine's Gulls

In 1997, a record 42 were recorded off Strumble during the period Aug. 29th – Oct. 13th, including 8 on Sept. 6th and 12 on Sept. 13th. This was also a good year elsewhere in the UK, where a further 341 were recorded, mainly in the south-west.

The highest annual total for the UK was in 1987 when a total of 710 were recorded. Of these, 25 were seen off Strumble, during the period Sept. 10th – Oct. 18th, including 5 on Oct. 10th.

BONAPARTE'S GULL

Larus philadelphia *GWYLAN BONAPARTE*

A juvenile was observed at Strumble on Sept. 28th 1997. This was the second county record; the first was shot at Solva in the spring of 1888.

SANDWICH TERN

Sterna sandvicensis *MORWENNOL BIGDDU*

Sandwich Terns occur on passage from mid March until late May in the spring, and in autumn from mid-July until early October with stragglers until early November. Large numbers, up to 1,200, were counted passing Strumble Head in autumn (Fig. 17), with a peak in mid-September.

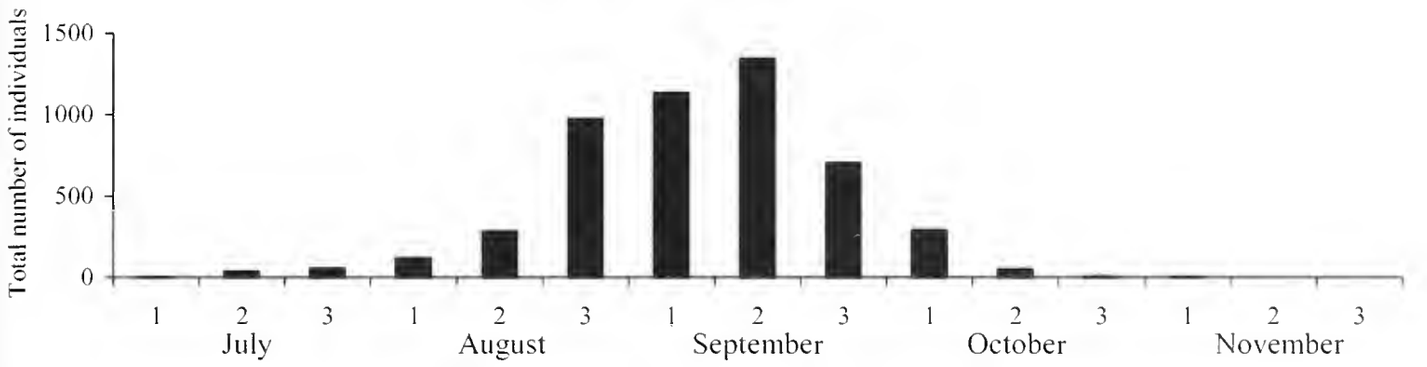


Fig. 17 Passage of Sandwich Terns off Strumble Head 1994 - 2001

The peak counts of Sandwich Tern on the Dee estuary, at Point of Air, are in late July. Birds then appear to move down the Welsh coast, stopping off at the estuaries of the Mawddach, Dysynni and Dyfi (Ynyslas) on their way south. Numbers at these sites peak in late August. The later Strumble pattern shown above, reflects this passage. The greatest numbers appear to occur on SE winds (personal obs).

ROSEATE TERN

Sterna dougallii *MORWENNOL WRIDOG*

A total of 25 individuals, all adults, have been seen passing Strumble Head. Fig. 18 summarises the records and compares them with Little Tern.

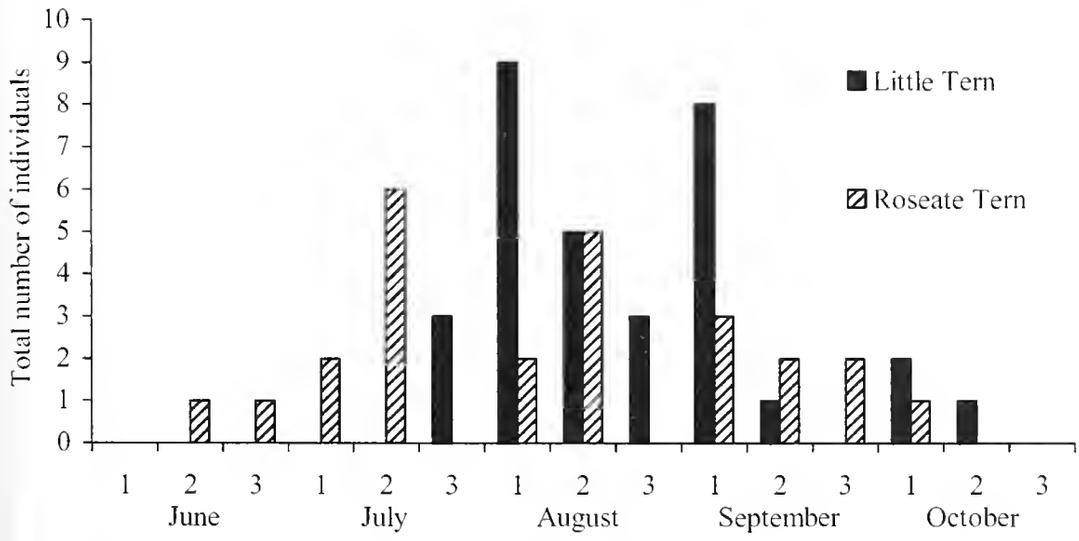


Fig. 18 Distribution of Little and Roseate Terns

COMMON TERN

Sterna hirundo *MORWENNOL GYFFREDIN*

Up to 100 are logged passing Strumble Head each autumn. Passage starts at the end of July and lasts until the 1st week of November.

ARCTIC TERN

Sterna paradisaea *MORWENNOL Y GOGLEDD*

This species is recorded more often but in smaller numbers than Common Tern, as it tends to pass further off shore. The largest counts come from Skokholm, where 149 were logged passing in autumn 1997, compared to less than 50 off Strumble Head.

LITTLE TERN

Sterna albifrons *MORWENNOL FECHAN*

Only 32 have been logged passing Strumble Head, mainly in early August and early September (Fig. 17).

BLACK TERN

Chlidonias niger *CORSWENNOL DDU*

A total of 903 individuals have been counted passing Strumble Head during the ten years. Annual totals are usually just less than 100 (the lowest was 7 in 2003) but 327 were counted in 1997 and 182 in 2001. By far the largest numbers pass in late August (Fig. 19).

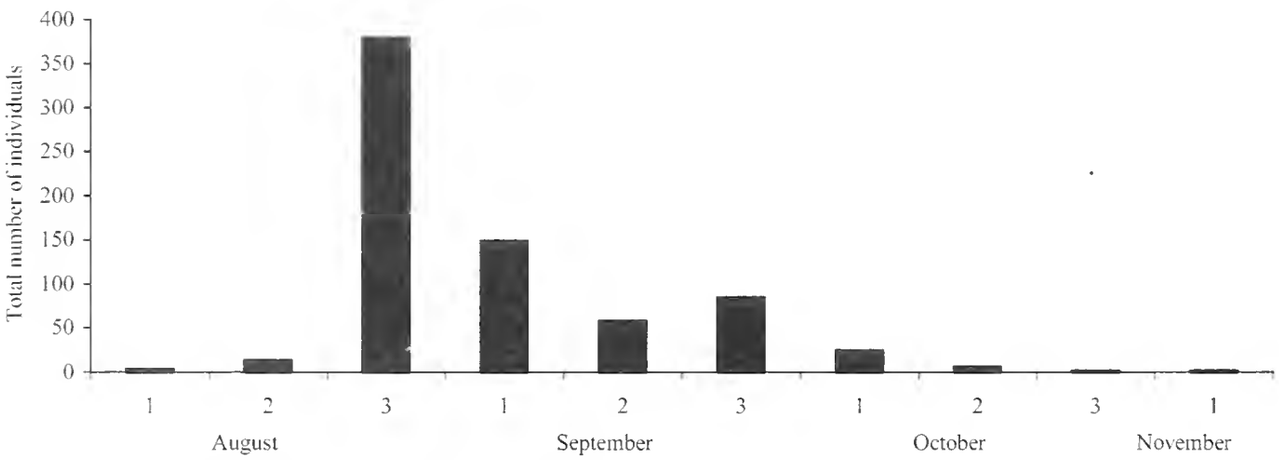


Fig. 19 Distribution of Black Terns

WHITE-WINGED BLACK TERN

Chlidonias leucopterus *CORSWENNOL ADEINWEN*

Two records; an adult on Oct. 15th 1997 and a juvenile on Aug. 1st 1999.

GUILLEMOT

Uria aalge *GWYLOG*

Small parties of Guillemots, of up to 50 birds, can be seen passing on a daily basis from September onwards. Large movements were recorded in late autumn 1999, when a total of 34,000 was counted on 5 dates between Nov. 5th – Dec. 3rd.

RAZORBILL

Alca torda *LLURS*

As with the last species, small parties, 50+ strong, can be seen from September onwards passing Strumble Head. Large movements were recorded on three occasions in October; 8,000 in 7 hours on Oct. 10th 1997 with 11,000 on the 12th and 12,000 in 7 hours on Oct. 2nd 2000.

BLACK GUILLEMOT

Cepphus grylle *GWYLOG DDU*

Six records, all of singles: on Aug. 28th & Sept. 20th 1999, July 11th and Nov. 3rd 2000, Oct. 23rd 2002 and Dec. 2nd 2003.

LITTLE AUK

Alle alle *CARFIL BACH*

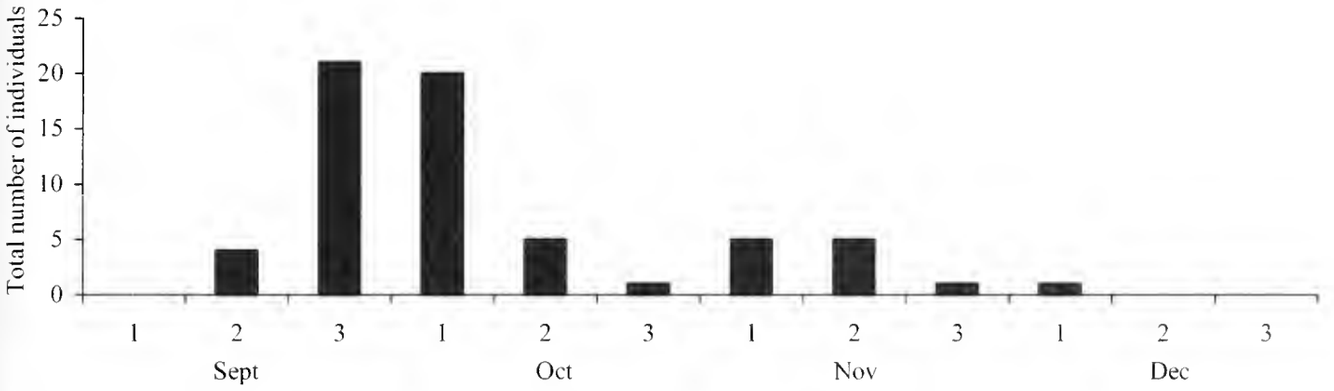


Fig. 20 Distribution of Little Auk

The occurrence of this tiny auk is related to the conditions out in the Atlantic and a total of 82 have been logged passing Strumble Head, usually on strong N winds. There is a clearly defined main peak in late September - early October, and a smaller one in early – mid November (Fig. 20). The latter peak is in line with the occurrence off the East coast of the UK, where strong Northerly winds in late October and November may bring large numbers, sometimes in their thousands past the headlands of Flamborough, Filey and Spurn. 1995 brought a large movement past the East coast, 1,350 past Sheringham, Norfolk on one day and an estimated 40,000 past Flamborough in the first half of November. This year also brought the highest annual total (33) off Strumble, and the highest daily total, 13. However these large counts were in September not November. These and other records in late September – early October are harder to explain as there are no supporting records from the East coast, where early autumn records are usually ascribed to confusion with juvenile Puffins. It is possible that these west coast observations could be erroneous, or that these birds originate from elsewhere. However there are no supporting records from North Wales.

COMPARISONS WITH OTHER WELSH SEA-WATCHING SITES

Compared to Strumble, there was generally far less sea-watching activity carried out at the only other two sites, Bardsey and Point Lynas. At the former, this relates to the amount of the warden's spare time that could be put into sea-watching and then only in suitable weather conditions. During 1976 – 1993 counts from Point Lynas were co-ordinated but less so during the rest of the 1990's. More recently there has been a revival of interest at this headland. Dare (1996) described sea-bird movements from Point Lynas during the period 1976-1993. Generally the results from this earlier study show a similar pattern to those since 1993, but the number of birds recorded was less than nowadays. These differences may relate in the past to fewer observers and poorer optical equipment. Table 2 compares results from both of the north Wales' sites with those from Strumble. Data have been extracted from Welsh Bird Reports 1994 – 2003 (Shrubb 1994 - 1997, Shrubb and Green 1998 - 1999, Green 2000 - 2003) and Birds in Wales 1992-2000 (Green 2002). The counts in brackets are those from the earlier Point Lynas study (Dare 1996).

Table 2. Comparisons of seabird passage between Bardsey, Point Lynas and Strumble Head, 1994 – 2003.

Red-throated Diver (1,437)	More are seen passing Point Lynas than Strumble. At Point Lynas 189 were counted in 2001, 186 in 2002 and 254 in 2003 compared to 177, 92 and 104 from Strumble in the same years. Presumably the higher numbers in north Wales, refer to individuals moving into the main wintering areas of north Cardigan Bay.
Great Northern Diver (115)	Numbers very similar.
Cory's and Great Shearwaters (5)	There are very few accepted records from North Wales (1 Cory's and 2 Great). This ties in well with the idea of birds moving off southern Ireland, or feeding in the SW approaches, then being blown up into the southern Irish Sea by SW gales. Very rarely would they be blown north to Bardsey or Point Lynas.
Sooty Shearwater (22)	Very few are seen from the north Wales coasts, annually less than 10 off Bardsey and Point Lynas. The only exception was in 1994, when 55 were seen off Bardsey. This was also the peak year for Strumble (119).
Mediterranean Shearwater (8)	1999 was a peak year, 91 were recorded off Bardsey. Presumably an influx of birds, which got in amongst the Manx feeding flocks and moved up and down the Irish Sea. Only 3 were seen from Point Lynas in 2002, far fewer than usual, but 141 during September 2003 and 67 during October. This coincided with a large "summering" flock off the Gower coast, which numbered at least 250 birds.
Leach's Petrel (291)	Generally less than 15 are recorded from Bardsey and Point Lynas each year. The exception was September 2001, when 93 were seen from Bardsey, including 69 on the 13th. 163 were counted off the Little Orme during the period 9th – 16th, including 105 on the 13th and 42 on the 16th and 100+ passed Point of Air on the 15th, with 120 on the following day. These dates are similar to the large passage off Strumble, a total of 260, including 122 on the 16th.
Common Scoter (5,280)	Far fewer are recorded passing north Wales than off Strumble. E.g. 1,130 off Point Lynas in 2002 and 1,681 in 2003. These differences may relate to fewer observations in late summer, when large number may go past North Wales from Liverpool Bay.
Grey Phalarope	Very few records from north Wales. This ties in with the effects of SW storm pushing migrating birds into the south Irish Sea and are therefore seen passing Strumble.
Pomarine Skua (91)	Annually less than 10 are recorded from Bardsey and Point Lynas. The exception was of a total of 22 at the latter site in 2003, including 4 on Aug. 27th.
Arctic Skua (1,171)	Up to 100 are seen annually from Point Lynas and up to 60 from Bardsey.
Long-tailed Skua (4)	There have only been a handful of records each year from North Wales. The best year was 2001 when 11 were seen from Bardsey, while Strumble notched up 19. Interestingly only one was seen from Point Lynas in 2002, the same year that only 4 passed Strumble.
Great Skua (717)	Usually a total of around 25 are seen off Bardsey but 40 in 2001, and up to 50 off Point Lynas, with 64 in 2001. The same year brought 171 passed Strumble.
Sabine's Gull (17)	Small numbers are seen annually from Bardsey and Point Lynas. In 2001, a total of 18 were counted passing off Bardsey, including 8 on Sept. 8th and 11 off Point Lynas including 4 on the 8th. Strumble totalled 17. 13 were counted in 2003 off Point Lynas and 2 from Bardsey, compared with to only 6 off Strumble.
Black Tern (35)	Small numbers are recorded annually passing Bardsey and Point Lynas. The largest counts were of 143 off Point Lynas in 2000, including 70 on Sept. 20th. Strumble counted 87 in the
	same period, including 45 on Sept. 24th. 69 were counted off Point of Air on Aug. 27th 1997 – same as the Strumble peak of 112.
Little Auk (2)	Only a handful of records annually from north Wales, all in late October – mid November – similar to those from Strumble, except for 2001, when in a period of strong N/NW winds, 22 were counted from Bardsey on Oct. 31st (none were seen at Strumble on that date). There are no records in early autumn. This conflicts quite strongly with the Strumble data.

DISCUSSION

It was proposed in the introduction that SW gales push migrating sea-birds up into the Irish Sea, then as the wind drops they exit into the south-westerly approaches. If the wind veers to the West or North-West then these birds are blown closer to Strumble and are therefore easier to see. It is impossible to analyse the wealth of sea-bird data along with the weather patterns for each date, to prove or disprove these theories. Personal observations by the many sea-watchers however are that although there may be a small amount of passage on any wind (mainly Common Scoters) it is only when the wind is in the west that larger, more significant movements are observed. Indeed virtually all the large shearwaters (Cory's and Greats) that have been recorded off Strumble have been during such weather patterns, and the occurrence of Pomarine Skuas in November and December 1999 can also be explained by wind forcing or displacement from SW sources.

In most autumns there are repeated periods of SW winds and gales bringing with them birds into the range of the sea-watchers of Strumble. The exceptions were the autumns of 2002 and 2003 which were dominated by light easterly winds with few W / SW winds. These autumns were poor for sea-watching. The following table compares the mean counts during 1994-2001 with those for these two autumns.

	Mean counts 1994-2001	2002	2003
Cory's Shearwater	4.0	0	0
Great Shearwater	4.4	29	0
Mediterranean Shearwater	162.6	84	243
Sooty Shearwater	72.1	98	14
Grey Phalarope	17.3	4	9
Pomarine Skua	50.1	7	30
Arctic Skua	227.5	186	203
Long-tailed Skua	23.8	4	7
Great Skua	187.4	137	151
Sabine's Gull	13.6	7	6

Table 3. Mean counts at Strumble Head, 1994 – 2001, 2002 and 2003.

For the majority of species, the counts in these two years were down on the mean for the period. The exceptions were Great, Sooty and Mediterranean Shearwaters. Presumably individuals from the large numbers seen off Ireland and the SW, as already discussed, mingled with the local feeding flocks of Manx Shearwaters and moved into the southern Irish Sea in 2002 or 2003.

In light of the lack of westerly winds, the reduced passage of Skuas, Grey Phalarope and Sabine's Gulls probably refer to birds that have entered the Irish Sea through the north channel, then moved south. In the case of Arctic Skuas some may have come overland from the North Sea. Higher numbers of all these species were recorded in the other years when there were more SW / W gales, which pushed birds up from their normal migration track (round southern Ireland and into the Atlantic) into the southern Irish Sea.

The occurrence of the rarer Little Shearwater, Wilson's Petrel and Soft-plumaged Petrel have only been during "ideal conditions", namely a NW / W gale which had been preceded by a few days of strong SW winds. The lower totals from North Wales, particularly of Cory's, Great and Sooty Shearwaters also give evidence to this theory. These sites are too far north within the Irish Sea to receive the SW wind-displaced birds.

ACKNOWLEDGEMENTS

This account has not been possible without the thousands of hours of sea-watching that has been carried out by a large number of observers, to whom the author pays homage. Thanks must also go to Graham Rees, who as County Recorder and main "Strumbler" has allowed unlimited access to the individual species record cards, which contained all the data.

Thanks also to Stephen Berry (the only "Strumbler" who actually lives there) for his help, encouragement and personal thoughts and to Michael Young-Powell for his constructive comments. A special note of thanks to Peter Dare, who has acted as referee of this paper, for his constructive comments on an earlier draft of the paper and editing input. Thanks also to Chris Grayell for the use of his illustrations.

REFERENCES

Brown, A. & Grice, P. 2005. *Birds in England*. Poyser.
Dare, P. 1996. Autumn Seabird movements at Point Lynas, Anglesey during 1976-1993. *Welsh Birds* **1:3**:29-45.
Recent Reports 1994 – 2003. *British Birds.*
Scarce Migrant Reports 1995 – 2001. *British Birds.*
Ornithological Years 1994 – 1999. *British Birds.*
Green, J. 2002. *Birds in Wales 1992 – 2000*. Welsh Ornithological Society.
Green, J. Welsh Bird Reports 2000 – 2003. Welsh Ornithological Society.
Green, J. & Roberts, O. 2004. *Birding in Pembrokeshire*. Welsh Ornithological Society.
Olsen, K.M. & Larsson, H. 1997. *Skuas and Jaegers*. Pica Press.
Mather, J. 1986. *Birds of Yorkshire*. Helm.
Rees, G.H. Pembrokeshire Bird Reports 1987 – 2003. Wildlife Trust for South and West Wales.
Sheringham Bird Observatory Reports 1994-2000.
Shrubb, M. Welsh Bird Reports 1994 – 1997. Welsh Ornithological Society.
Shrubb, M. & Green, J. Welsh Bird Reports 1998 – 1999. Welsh Ornithological Society.

SHORT NOTES

AGGRESSIVE BUZZARD *Buteo buteo* IN CEREDIGION

The paper describing aggressive Buzzard behaviour in *Welsh Birds* 4 (1): 60-64 reminded me of an experience I had in the spring of 2002 in north Ceredigion.

I was walking on a coastal footpath about 3km. north of Llanrhystud in May 2002 when I experienced a sudden and totally unprovoked attack by a Buzzard. The bird came at me from behind out of the blue and must have passed within a few feet of my head. It gained height rapidly and dropped on me almost vertically again. The second 'stoop' was, I felt, closer and the third even more so. I held my tripod above my head and scurried away from the area.

On my return a short time afterwards the Buzzard picked me out again and I was attacked twice more from behind, this time I just ran. It certainly felt as if the bird would have caused physical injury unless I moved away very swiftly.

At no point had I attempted to approach or even look for a nest. There were no suitable nesting sites for Buzzards in the vicinity of the attack, although there may have been a nest on cliffs which dropped away to the sea nearby, but which were invisible to me.

I walked this stretch of the coast in the spring of 2004 and there was no sign of the aggressive bird.

Jeremy Moore, Cynefin, Capel Bangor, Aberystwyth SY23 3LU

OLDEST BRITISH-RINGED OYSTERCATCHER *Haematopus ostralegus* IS FOUND IN WALES

On February 14th 2003 I discovered the fresh corpse of a ringed Oystercatcher by Traeth Lavan Sands near Llanfairfechan, North Wales. Having submitted details to the BTO I was notified that this bird was originally trapped and ringed (SS62425) in the same locality on June 14th 1967. It was later recaptured there on July 28th 1984 by SCAN ringers and a replacement ring (FA14151) was fitted.

Realising that this was a very old bird I sent details of this find to my friend, Dr. Peter Dare, who had been ringing here during the 1960's as part of a MAFF study of Oystercatcher movements. Since the last recovery from that era had been about two years prior to his retirement, in 1994, from MAFF shellfisheries research, he had given up all hope of any more recoveries of his birds. Naturally, he was very excited when he heard of my find, for not only had he netted this individual but he was able to give some more details of its life history.

This Oystercatcher was from a catch at Abergwyngregyn of 94 over-summering immatures which Tony Mercer and he had ringed and colour-banded with individual

colour codes on June 14th 1967. Peter then saw it on a further nine occasions at Traeth Lavan, either at roost or feeding on cockles on the sands up to March 30th 1968. It was subsequently seen by a colleague in the following autumn at Beaumaris, Anglesey, on August 21st 1968 when feeding on a mussel bed. It was not seen again until it was retrapped by SCAN on July 28th 1984.

When originally trapped, Peter Dare judged this Oystercatcher to be in sub-adult plumage, i.e. either a 2nd or 3rd summer bird. It was therefore probably hatched in 1965, though possibly 1964; some Oystercatchers on Skokholm are nearly four years old when they first acquire adult breeding plumage. With a probable birth-year of 1965 this individual must have been at least thirtyseven and a half years old when it died. It has been confirmed by Mark Collier (BTO Recoveries Officer) that it is the oldest Oystercatcher yet recovered by the British ringing scheme. However, other potential contenders for the title may exist among Oystercatchers wintering in the Wash. There, on September 7th 2002 members of the Wash Wader Ringing Group recaught (controlled) a 36 years old Oystercatcher that had been ringed at Snettisham, Norfolk, on August 13th 1967. To quote Peter Dare: " How many more veteran Oystercatchers of the 'Swinging Sixties' are still out there?"

I was merely the finder of this bird and I am most grateful to Dr. Peter Dare for providing the interesting additional information and comments.

Julian Driver, Hafod y Fedwen, Gwyllt Road, Llanfairfechan, Conwy LL33 0EG

BREEDING WADERS IN WALES

The decline of breeding waders in Wales has been well documented (e.g. Lovegrove *et al.* 1994 and Green 2002) and is all too apparent in any surveys carried out in the last few years in different parts of Wales in habitats suitable for breeding waders.

Quantitative confirmation of the dramatic extent of the decline is now provided for lowland wet grasslands in the publication of the results of a survey of breeding waders in England and Wales in 2002, comparing the data with those gathered using identical methods in a survey in 1982 (Wilson *et al.* 2005). As in the 1982 survey lowland wet grassland was broadly defined as any area of grassland below 183m (600 feet) asl that is subject to freshwater flooding or waterlogging.

The results for Wales were:

Oystercatcher *Haematopus ostralegus*	6 pairs in 1982, 7 pairs in 2002
Lapwing *Vanellus vanellus*	353 pairs in 1982, 109 pairs in 2002
Snipe *Gallinago gallinago*	11 pairs in 1982, 12 pairs in 2002
Curlew *Numenius arquata*	100 pairs in 1982, 25 pairs in 2002
Redshank *Tringa totanus*	50 pairs in 1982, 19 pairs in 2002

Statistically significant changes were recorded for Curlew (-75%) and Lapwing (-69.1%) which were, notably, the greatest declines for these species in any of the nine regions of

England and Wales (eight English regions) used in the analysis. For all nine regions the changes totalled -38.9% for Curlew and -36.8% for Lapwing so that the declines were widespread, but most pronounced in Wales. Overall Snipe showed the greatest decline (-68%) but the sample for Wales, showing an increase of one pair, was too small to add to the picture.

Land use changes between the two surveys showed that there were statistically significant decreases overall of 27% in the area of hay meadows and of 23% in cattle grazing, whilst silage production increased by 64%, with resultant implications for the loss of eggs and of young waders and other ground-nesting birds to early silage cuts. In Wales the diminution of cattle grazing was particularly marked at -53% which was statistically significant, and a reflection, in part at least, of a change to high density sheep grazing systems.

In the gloomy picture shown by the recent survey there is the real danger that Lapwings, in particular, will soon be confined in Wales to the relatively few wet grassland reserves, amongst which are the Gwent Levels Wetland Reserve, Morfa Madryn Local Nature Reserve (and Tir Gofal site), Penclacwydd Wildfowl and Wetlands Trust Reserve and RSPB Reserves at Ynys Hir, Malltraeth Marsh, Valley Wetlands, Conwy and Ramsey Island. It is unfortunate that in the Dee flood plain, the main Lapwing stronghold outside the Dyfi valley, most birds nest in maize stubble where cultivations result in very poor breeding success. One ray of hope is that the agri-environment scheme (Tir Gofal), administered at present by the Countryside Council for Wales, includes a Lapwing specific option which it is hoped will assist a Lapwing recovery at some sites.

REFERENCES

Green, J. 2002. *Birds in Wales 1992-2000.* Welsh Ornithological Society

Lovegrove, R., Williams, G and Williams,I. 1994. *Birds in Wales.* T. and A. D. Poyser

Wilson, A. M., Vickery, J. A., Brown, A., Langston, R. H. W., Smallshire, D., Wotton, S. and Vanhinsbergh, D. 2005. Changes in the number of breeding waders on lowland wet grasslands in England and Wales between 1982 and 2002. *Bird Study* **52**: 55-69

Graham Williams, 14 Dolerw Park Drive, Newtown, Powys SY16 2BA

POLYGYNY IN WELSH LAPWINGS

The Lapwing (*Vanellus vanellus*) is traditionally regarded as a monogamous species (e.g. Cramp & Simmons 1982), with polygamy occasionally occurring. Recently, however, studies of marked birds in northern England and Scandinavia have revealed a significant level of polygynous pairings, males having two or three mates and in one case four (Berg 1993, Byrkejedal *et al.* 1997, Parish *et al.* 1997, Hafsmo *et al.* 2001), indicating that polygamy is a frequent mating strategy.

In 2005 I studied a small breeding population on Penllyn marsh, just south of Tywyn, Meirionnydd. At its maximum in April this population comprised 11-12 males and seven females. It quickly became obvious in early April that one male had two females, which

went down on eggs on Apr. 1st and 2nd. At this stage three other males had mates and another was courting a female, whilst there remained 6-7 bachelors displaying. On Apr. 5th I observed that the bigamous male was trying to attract a third female, which I suspected was the female of the courting male whose territory abutted his. He successfully seduced this female, who began incubating a clutch on Apr.12th. This male then had a row of three females incubating along the margins of a large puddle in his territory. Heavy rain over Apr. 18/19th flooded all three nests but the male retained all the females who were all successfully incubating new clutches 10-14 days later. Interestingly, the male enticed two of his mates out into the drier part of his territory for their second attempts.

In the interim a male holding territory on the other side of the cuckolded bird usurped his territory, although I am unclear whether the bird left or was pushed. I then observed that the usurper had acquired a second female who was incubating eggs on Apr. 18th. Shortly afterwards his primary female was predated, vanishing overnight. During May three of the bachelor males acquired mates and nests and the remaining males left the area.

Thus this population finally involved seven 'pairs' of which five were monogamous and two (29%) polygynous. This proportion agrees well with that recorded in the other studies referred to above and, as with those studies, polygyny occurred despite the presence of bachelor males with which the secondary females could have paired. Polygyny probably goes with age and experience. Most Lapwing males that fail to attract mates and breed are probably yearlings and females clearly prefer secondary status with an older experienced male than primary status with a less experienced one.

REFERENCES

Berg, A. 1993. Habitat selection by monogamous and polygamous Lapwings on farmland – the importance of foraging habitats and suitable nest sites. *Ardea* **81**: 99-105.

Byrkjedal, L., Gronston, G.B., Lislevand, T.. Pedersen, K.M., Sandvik, H. & Stalheim, S. 1997. Mating systems and teritory in Lapwings *Vanellus vanellus. Ibis* **139**: 129-137.

Cramp, S. & Simmons, K. E. L. (eds.). 1982. *The Birds of the Western Palaearctic Vol. 111.* Oxford University Press.

Hafsmo, J. E., Byrkejedal, I., Gronston, G. B. & Lislevand, T. 2001. Simultaneous tetragyny in Northern Lapwing *Vanellus vanellus. Bird Study* **48**: 124-125.

Parish, D. M. B., Thompson, S. & Coulson, J. C. 1997. Mating systems in the Lapwing *Vanellus vanellus. Ibis* **139**: 138-143.

Michael Shrubb, 39 Copperhill Street, Aberdyfi, Gwynedd LL35 0HL

WELSH BIRDS

'Welsh Birds' is the journal of the Welsh Ornithological Society and is published twice a year, in June and December. The December issue is primarily devoted to the Welsh Bird Report and the annual report on Bird Ringing in Wales.

Papers for 'Welsh Birds' are welcomed by the Editor on any aspect of Welsh ornithology. The Society is anxious that the journal should accurately reflect present ornithological activity in Wales. Thus we hope that all workers, professional or amateur, with results of bird studies in Wales, will always consider publishing information about these here. All papers will be reviewed by the Editor and an independent referee. Authors should follow the format of papers published in the journal and guidelines for authors have been drawn up and are available from the Editor (address inside front cover). Papers are accepted and published in either Welsh or English. In accordance with standard international practice papers in Welsh should be supplied with captions to tables and figures in both Welsh and English and with an English summary.

Short notes on interesting or unusual features of behaviour recorded in Wales are also welcomed. An accumulation of such items is of considerable value. Notes should be short and succinct, ideally of not more than half a page in length. Notes may also be submitted in either Welsh or English.

Designed and Printed by Severn Media Group Limited, Newtown. Tel. 01686 622365.

Bound by